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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

IMPORTANT PROPERTIES OF N-RAYS.

One of the important properties of N-rays, the new radiation discovered recently by Blondlot, is that they can be reflected and refracted while they have penetrative powers similar to Rœntgen rays. They do not, however, affect a photographic plate and are, of course, invisible. But when a screen has been devised which will render them visible it will then be possible to obtain perspective images of hidden bodies, such as a diseased bone, and this will give these rays as great an advantage over the X-rays as the photograph has over the old black-and-white silhouette.

N-Rays May Aid in Illumination.

Another fact connected with N-rays has been discovered by Blondlot and since confirmed by Reubens, which may prove to be of great importance in another field of application. This is the fact that these rays enhance the luminosity of a glowing solid or gas without increasing its temperature. The explanation of this effect has not yet been offered, but any means which will enable us to increase the luminosity of a body without increasing its temperature promises to be of great importance in solving the problem of an efficient light.

MATTER AND ELECTRICITY.

We are used to hearing enthusiasts expatiate upon the wonders of electricity, what great things it has done; what greater wonders it will yet do; what revolutionary forces have been set to work as the result of a patient study of apparently an uncommon physical phenomenon. After working his readers up to a state of almost reverential respect for the physicist and his brother, the engineer, the author not unfrequently gives way to the temptation to add to the bewilderment of his readers by saying "And yet no one knows what electricity is."

Knowledge of Electricity Comparatively Full.

This is, of course, true enough, but there are other branches of physical science in which we are more ignorant than in that called "electricity." Doubtless most of us are under the impression that we know something about the materials surrounding us and with which we come into such constant and intimate contact. It will, therefore, come as a surprise to many to read the statement made by Sir Oliver Lodge during a recent address entitled "Modern Views on Matter" bearing on this subject. Sir Oliver said: "It is possible, but to me very unlikely, that the electron, as we know it, contains a material nucleus in addition to its charge, so in that case it need not be so concentrated because a portion of its mass would be otherwise accounted for. I say 'accounted for,' but it would be equally true to say unaccounted for. The mass which is explicable electrically is to a considerable extent understood, but the mass which is merely material (whatever that may mean) is not understood at all. We know more about electricity than about matter; and the way in which electrical inertia is accounted for electromagnetically and localized in the ether immediately surrounding the nucleus of charge is comparatively clear and distinct." In other words, we know more about the laws which govern this invisible agent than we do about the most commonplace matter.

Possible Relation Between Electricity and Matter.

This statement is, of course, strictly true. It needs only to be made to be acquiesced in. We are, or rather we think we are, so familiar with things which we can see and handle that they seem commonplace, but to be able to control an invisible agent seems most wonderful. It is possible that before many years we will discover that we really know more about matter than we now think we do; at least this will be the case if the suggestions made by Sir Oliver Lodge should be sustained by later discoveries. He has thrown himself enthusiastically into the study of the new theories of electricity, and as a result of these studies he has been led to certain ideas which are not entirely assented to by his brother physicists. But it should be remembered that Sir Oliver Lodge is ever most careful to distinguish between theories which seem to be well supported by facts and mere hypothesis thrown out to stimulate research and discussion. Sir Oliver's idea is that an atom of matter is made of a staple group of electrons, and electrons themselves are merely electrical charges. He thinks that all the properties of matter can be accounted for in this way and are merely the result of electrical forces. Should this be true we may then begin to feel that we know something about matter, for an atom of matter may be nothing more than a crystal of electricity.

PARIS TUNNEL DISASTER.

In the news columns of this issue will be found details of the terrible disaster in the Paris subway in which a large number of lives were lost. It is well nigh impossible to locate the blame for this calamity or to give a precise explanation of the cause of the fire. Tunnel disasters have always been looked upon with particular dread, and an accident occurring in a tunnel where train service is frequent and speeds fairly high and where the passengers are plunged suddenly into total darkness by the simultaneous extinguishing of all the train and tunnel lights is likely to cause a panic among the coolest heads. Add to this condition the blunder which enables another train to plunge into the crowd of passengers seeking to escape from the burning train and suffocating smoke by grouping their way along a dark tunnel, and it is hard to conceive of a more terrifying situation.

What Is the Possibility of an Accident Here?

The immediate effect of this lamentable accident has been to raise the question of the possibility of a similar occurrence taking place in one of the subways which are now being constructed or to be constructed in a number of our larger cities. There is, of course, always present the danger of collision whether above the ground or underground, but with the improved appliances for safeguarding trains this danger is becoming less and less.

Fire Protection.

To protect against fires the train should be as nearly fireproof as it is possible to make it. This danger exists on all lighted trains to a more or less extent, but it has been very greatly reduced by the introduction of electric lights. The cars which will be used by the Interborough Transit Company on the New York subway will be protected by metal and asbestos, and the combustible material reduced to a minimum, and means are provided for shutting off the current in case of an accident. When the power is shut off there will be nothing to cause a fire. All these questions have been under discussion by the officials of the Interborough Transit Company for several years, and all possible safeguards have received careful attention.

Greatest Danger in Panics.

There is one other point which should be remembered in this connection. Although the Paris accident happened to electrically operated trains, it does not follow that the blame should be laid to this kind of motor power. The conditions were such that it was almost impossible to determine just what happened, but the disaster emphasizes the need already recognized by those responsible for the New York subway of taking every precaution possible to avoid any such occurrence here. In an accident of this kind the greatest danger lies in a panic among the passengers and that many of the train officials escaped from the Paris wreck seems to indicate that more of the passengers might have escaped had they kept cool. In electrically operated trains there may be flashes of light and perhaps an occasional blowing of a fuse with something of a report and perhaps some smoke, but this must be expected and does not indicate danger. A fuse is nothing more than an electrical safety valve and no one is frightened when a locomotive blows off steam.

Public Should Have Confidence.

It is our belief that whatever can be done to promote the safety and comfort of passengers on the New York subways will be done. This is the largest electrical development that has ever been undertaken, and not only would it be bad policy to slight the least detail, but the character of the men in authority and the recognized ability of their engineers should inspire public confidence.

EXPIRATION OF THE BRITISH PATENT ON THE PARSONS STEAM TURBINE.

In 1884 the British patent was granted to the Hon. C. A. Parsons on a new type of prime mover now known as the steam turbine. Due to the importance of this invention and the difficulties met in bringing it to a satisfactory commercial standing, the patent was extended five years and this extension has now expired, throwing open this field of work to the public.

It is interesting to note at this time the opinion of Lord Kelvin, who has described the invention of the steam turbine as the greatest advance made in steam engineering practice since the time of James Watt. As was true of Watt was also true of Parsons, that he was thoroughly equipped with theoretical knowledge and was an expert mechanic. In developing the turbine, there was thus combined, theoretical knowledge, mechanical skill and capital. The result has been a machine which bids fair to become most important, but it can hardly be said that the inventor, even with the extension of his patent, has received the full reward of his labors.

RADIUM FOR TREATING CONSUMPTION.

In a recent issue of the British *Medical Journal* Mr. Frederick Soddy suggests the use of radioactive materials to treat consumptives. It has been demonstrated by Crookes and others that the radiation from radium is a powerful germicide and it has been shown by Rutherford and Soddy that this material gives off a gas which is itself radioactive. Thus to treat a consumptive patient it will only be necessary to cause him to inhale this emanation in order to reach at once the diseased tissues. Thorium may also be used for this purpose and although it is less powerful than radium, its emanation is given off much more rapidly. These emanations tend also to excite a secondary radioactivity of the surface with which they come in contact, which will prolong the germicidal action. It is possible that these important discoveries in the sciences of physics and chemistry may have as great importance in that of medicine. Thus to quote Mr. Soddy in the above communication: "The immunity of these processes from external interference, the simple nature of the treatment proposed, the infinitesimal quality of the active agents employed, the manner in which the emanations may be inhaled to do their work at the very seat of the disease, leaving behind in their place the secondary activity to continue to work in a gentle manner after they have been exhaled, make out a strong case why the attention of medical men should be directed to these new weapons which physics and chemistry have placed at their disposal."

SWITCHING TRANSMISSION CIRCUITS.

BY ALTON D. ADAMS.

Electrical transmission has worked a revolution in the art of switching. As long as the distances to be covered by distribution lines required pressures of only a few hundred volts the switch contacts for generators and feeders could well be exposed in a row on the surface of vertical marble slabs and separated from each other by distances of only a few inches. These switches were capable of manual operation even at times of heavy overload without danger of personal injury to the operator or of destructive arcing between the parts of a single switch or from one switch to another near-by. On the back of these marble slabs one or more sets of bare bus-bars could be located without much probability that an accidental contact between them would start an arc capable of destroying the entire switchboard structure and shutting down the station.

The rise of electric pressures to thousands and tens of thousands of volts in distribution and transmission systems has vastly increased the difficulty of safe and effective control with open air switches. The higher the voltage of the circuit to be opened under load the greater must be the distance between the contact parts of each switch, and also between adjacent switches. Such switches must also be further removed from the operators as the voltages of their circuits go up, as a person can not safely stand very close to an electric arc of several feet or even yards in length. In the West where long transmissions are most common long break stick switches have been much used with high voltages. These switches depend on the length of the break to open the circuit and on the length of the stick that moves the switch jaw or plug to ensure the safety of the operator. Where switches of this sort are used it is highly important to have ample distances between the contact points of each switch and also between the several switches. On circuits of not more than 10,000 volts an arc as much as a yard long will in some cases follow the opening switch blade and hold on for several seconds. On the 33,000-volt transmission system at Los Angeles a peculiar form of switch is used which makes a break between a pair of curved wire horns that are ten inches apart at their nearest points. When the contact between these horns is broken the arc travels up between portions of the horns that curve apart and is thus finally ruptured. Besides the very large space required for open switches on circuits of 5,000 to 10,000 volts or more, there is the further objection that the arcs developed by opening such switches under heavy loads rapidly destroy the contact parts and produce large quantities of metallic vapor that is objectionable in a central station. In some experiments performed at Kalamazoo (A. I. E. E., Vol. xviii, p. 407) with open air switches the voltages ranged from 25,000 to 40,000. The loads on circuits broken by the switches were highly inductive and amounted from 1,200 to 1,300 kilovolt-amperes. At 25,000 volts the arc produced by the open air switch held on for several seconds. At 40,000 volts the arc following the opening of this switch was over thirty feet long, and being out of doors near the pole line the arc struck the line wires and short-circuited the system. It has been shown that the oscillations of voltage occurring when a circuit under heavy load is opened by an open air switch may be very dangerous to insulation (A. I. E. E., Vol. xviii, p. 383). In the Kalamazoo test the oscillations of this sort were reported to have reached two or three times the normal voltage of the system when the open air switch was used.

Facts of the nature just outlined have led to the development of oil switches. The general characteristic of oil switches is that the contact parts are immersed in and the break between these contacts takes place under oil. Two distinct types of the oil switch are made, one having all of its contact parts in the same bath of oil and the other having a separate oil bath for each contact. Compared with those of the open air type, oil switches effect a great saving of space, develop no exposed arcs or metallic vapors, cause little if any oscillation or rise of voltage in an alternating circuit and can be depended on to open circuits of any voltage and capacity now in use. In the tests above mentioned at Kalamazoo a three-phase oil switch making two breaks in each phase and with all the six contacts in a single oil bath was used to open circuits of 25,000 volts and 1,200 to 1,300 kilovolt-arcs with satisfactory results. At 40,000 volts, however, this type of switch spat fire and emitted smoke, indicating that it was working near its ultimate capacity. A three-phase switch with each of its six contacts in a separate cylindrical oil chamber was used to open the 40,000-volt 1,300 kilovolt-arc circuit at Kalamazoo with perfect success even under conditions of short-circuit and without the appearance of fire or smoke at the switch. The three-phase switch used in the tests at Kalamazoo and having each of its contacts in a separate oil chamber was similar in construction to the switches used in the Metropolitan and Manhattan railway stations in New York city. In each of these switches the two leads of each phase terminate in two upright brass cylinders. These cylinders have fibre linings to prevent side jumping of the arcs when the switch is opened, and each cylinder is filled with oil. Into the two brass cylinders of each phase dips a ∩-shaped contact piece through insulating bushings, and the ends of this contact piece fit into terminals at the bottom of the oil pots. A wooden rod joins the centre or upper part of the ∩ contact piece, and the three rods of a three-phase switch pass up through the switch compartment to the operating mechanism outside. The six brass cylinders and their three ∩ contact pieces are usually mounted in a switch cell built entirely of brickwork and stone slabs. For a three-phase switch the brick and stone cell has three entirely separate compartments and each compartment contains the two brass cylinders that form the terminals of a single phase. On top of and outside the cell the mechanism for moving the wooden switch rods is mounted. In the Metropolitan station, where the voltage is 6,000, the vertical movement of the ∩-shaped contact piece with its rod is twelve inches. At the Manhattan station, where the operating voltage is 12,000, the vertical movement of the ∩ contacts in opening a switch is seventeen inches. The total break in each phase in a switch at the Metropolitan station is thus twenty-four inches or four inches per 1,000 volts, and the total break per phase in switches at the Manhattan station is thirty-four inches or 2.66 inches per 1,000 volts total pressure.

Oil switches are now very generally employed on alternating circuits that operate at 2,000 volts or more for purposes of general distribution. On circuits of moderate voltage like that just named, and even much higher, it is common practice to use oil switches that have only a single reservoir of oil each, the entire six contacts in the case of a three-phase switch being immersed in this single reservoir. Such switches are usually operated directly by hand and are located on the backs of or close to the slate or marble boards on which the handles that actuate the switch mechanism are located. A

good example of this sort of work may be seen at the substation in Manchester, N. H., where energy from four water power stations is delivered over seven transmission lines and then distributed by an even larger number of local circuits at 2,000 volts three-phase. At the Garvins Falls station, one of the water power plants that delivers energy to the substation in Manchester, the generators operate at 12,000 volts three-phase and these generators connect directly with the bus-bars through hand-operated oil switches located on the back of the marble switchboard. These last-named switches, like those at the Manchester substation, have all the contacts of each in a single reservoir of oil.

With very high voltages, where only a few hundred kilowatts are concerned, and also with powers running into thousands of kilowatts at as low a pressure as 2,000 volts, it is very desirable to remove even oil switches from the switchboard and the vicinity of the bus-bars. Great powers as well as very high voltages not only increase the element of personal danger to an attendant who must stand close to a switch while operating it, but also render the damage to other apparatus that may result from any failure of or short-circuit in a switch much more serious.

As soon as switches are removed to a distance from the operating board the necessity for some method of power control becomes evident, since the operator at the switchboard should be able to make or break connections of any part of the apparatus quickly. The necessity for the removal of switches for very large powers to a distance from the operating boards and for the application of mechanical power to make and break connections was met before the development of oil switches. Thus at the first Niagara (A. I. E. E., Vol. xviii, p. 489) power-house, in 1893, the switches for the 3,750-kilowatt, 12,200-volt generators, though of the open air type, were located in a special switch compartment erected in the generator room and over a cable subway at some distance from the operating board. These switches were actuated through compressed-air cylinders into which air was admitted by the movement of levers near the switchboard. Evidently a switch of this capacity—1,000 amperes per pole and 2,200 volts, two-phase—could not well be operated by hand power wherever located, because of the large effort required. In the second generating station at Niagara Falls oil switches similar to those used at the Manhattan Elevated Railway plant in New York, but two-phase, were employed. Each oil switch at Niagara Falls has a capacity of 5,000 horse-power, like the previous open air switches, and is electrically actuated.

In these electrically operated oil switches a small motor is located on top of the brick cell that contains the contact parts, and this motor releases and compresses springs that open and close the switch. While it is not desirable to employ open air switches to open circuits of several thousand or even hundreds of kilowatts at voltages of 2,000 or more, it is nevertheless possible to do so. This is shown by the experience at the first Niagara Falls station, where the 2,200-volt two-phase switches are reported to have opened repeatedly currents of more than 600 amperes per phase without injurious sparking. The great rise of voltage that was shown by the experiments at Kalamazoo to follow the opening of a simple open air switch was avoided at the first Niagara switches by a simple expedient. In these 5,000-horse-power open air switches a shunt of high resistance was so connected between each pair of contacts that the blades and jaws that carried the main body of the current never completely opened the circuit. When the main jaws of one of these switches were opened the shunt resistance continued in circuit until subsequently broken at auxiliary terminals. That no excessive rise of voltage took place when one of these switches was open was shown by connecting two sharp terminals in parallel with the switch and by adjusting these terminals to a certain distance apart. Had the voltage risen on opening the switch above the predetermined amount there would have been an arc formed by a spark jumping the distance between the pointed terminals.

Safety and reliability of operation at very high voltages, say of 5,000 or more, require that each element of the equipment be so isolated as well as insulated from every other element that the failure or even destruction of one element will not seriously endanger the others. With this end in view the cables from each generator to its switch should be laid in a conduit of brick or concrete that contains no other cables. The brick or stone compartment for each phase of each switch should be so substantial that the contacts of that phase may arc to destruction without injury to the contacts of another phase. Bus-bars, like switches, should be removed from the operating switchboard, because an arc between them might destroy other apparatus thereon and even the board itself. It is not enough to remove bus-bars from the switchboard where very high voltages are to be controlled, but each bar should be located in a separate brick compartment so that an arc can not be started by accidental contact between two or more of the bars. It is convenient to have the brick and stone compartments for bus-bars built horizontally one above the other. The top and bottom of each compartment may conveniently be formed of stone slabs with brick piers on one side and a continuous brick wall on the other to hold the stone slabs in position. Connections to the bus-bars should pass through the continuous brick wall that forms what may be termed the back of the compartments. To close the openings between the brick piers at the front of the compartments movable slabs of stone may be used. Feeders passing away from the bus-bars, like dynamo cables running to these bars, should not be grouped close together in a single compartment but each cable or circuit should be laid in a separate fireproof conduit to the point where it passes out of the station.

The folly of grouping a large number of feeders that transmit great powers together in a single conduit was well illustrated by the accident that destroyed the cables that connected the first Niagara Falls power station with the transformer house on January 29, 1903. On the evening of that day lightning short-circuited one of the cables in the short bridge that connects No. 1 station with the transformer house, and all the cables in this bridge, supplying local consumers as well as railways and lighting in Buffalo, were destroyed. This bridge contained probably more than thirty-six cables, as that number of new cables were put in position within twenty-four hours after the accident, and these cables covered with inflammable insulation were huddled closely together. The result was not only the loss of the cables, but also of many times their value in the damage to power users. If these cables had been located in separate fireproof conduits, it is highly probable that only the one directly affected by lightning would have been destroyed.

The brick and stone compartments for bus-bars may be located in the basement underneath the switchboard, as at the Portsmouth station of the New Hampshire Traction Company, or at any other place in a station where they are sufficiently removed from the other apparatus. In power-house No. 2 at Niagara Falls a cable subway beneath the floor level runs the entire length, parallel with

the row of generators (A. I. E. E., Vol. xlx, p. 537). In this subway, which is thirteen feet nine and three-quarter inches wide and ten feet six inches high, the two structures for bus-bar compartments are located. Each of these structures measures about 6.6 feet high and 1.8 feet wide, and contains four bus-bar compartments. In each compartment is a single bar, and the four bars form two sets for two-phase working. Above the bus-bar compartments and rising from the floor level are the oil switches. A space over the cable subway midway of its length and between the two groups of oil switches is occupied by the switchboard gallery which is raised to some elevation above the floor and carries eleven generator, twenty-two feeder, two interconnecting and one exciter panels. In power-house No. 1 the bus-bars are located in a common space above the 5,000-horse-power open air switches already mentioned and each bar has an insulation of vulcanized rubber covered with braid and outside of this a wrapping of twine. Of course, an insulation of this sort would amount to nothing if by any accident an arc were started between the bars. Where each bus-bar is located in a separate fire-proof compartment, as at Niagara power-house No. 2, the application of insulation directly to each bar is neither necessary nor desirable. Consequently the general practice where each bar has its own fire-proof compartment is to construct the bars of bare copper rods.

With main switches for generators and feeders removed from the operating board and actuated by electric motors or magnets, the small switches at the board with which the operator is directly concerned must of course control these magnets or motors. The small switches at the operating board are often called relay switches, and the current in the circuits opened and closed by these switches and used to operate the magnets or motors of the oil switches may be conveniently obtained from a storage battery or from one of the exciting dynamos if a battery is not to be had.

Probably the best arrangement of the relay switches is in connection with dummy bus-bars on the face of the switchboard, so that the connections on the face of the board constitute at all times a diagram of the actual connections of the generator and feeder circuits. It is also desirable for quick and correct changes in the connections of the main apparatus that all the relay switches and instruments necessary for the control of any one generator or any one feeder be brought together on a single panel of the switchboard. If this plan is followed the operator at any time will have before him on a single panel all of the switches and instruments involved in the connections then to be made, and the chance for mistakes is thus reduced to a minimum. The plan just outlined was that adopted at the Niagara power plant No. 2, where a separate panel is provided for each of eleven generators and each of twenty-two feeders. On each of the eleven generator panels there are two selector relay switches, one generator relay switch and one relay generator field switch. On each of the twenty-two feeder panels there are two relay selector switches. The relay switches on the two interconnecting panels serve to make connections between the two groups of five and six generators, respectively, in power-house No. 2 and the ten generators of power-house No. 1. On each panel there are relay indicators to show whether the oil switches that carry the main currents respond to the movements of their relay switches.

Where the electric generators operate at the maximum voltage of the system, as at Garvins Falls and in the power-house of the Manhattan Elevated Railway, there may be said to be only one general plan of connections possible. That is, the generators must connect directly with the main bus-bars at the voltage of the system, and the feeders or transmission lines must also connect to these same bars. Of course there may be several sets of bus-bars for different circuits or classes of work, but this does not change the general plan of through connections from generators to lines. So, too, the arrangement of switches is subject to variations, as by placing two switches in series with each other in each dynamo or feeder cable, or by connecting a group of feeders through their several switches to a particular set of bus-bars and then supplying this set of bars from the generator bus-bars through a single switch.

Where the voltage of transmission is obtained by the use of step-up transformers, the connections of these transformers may be such as to require nearly all switching to be done on either the high or low-tension circuits. The more general practice is to do all switching in the generator circuits and on the low-tension side of transformers, except in the connection and disconnection of transformers and transmission lines with the high-tension bus-bars, when not in operation. Where generators operate at the maximum voltage of the system only two main groups of switches are necessary, one group connecting generators to bus-bars, and the other group connecting bus-bars to the transmission lines. As soon as step-up transformers are introduced the number of switch groups must be increased to four if the usual method of connection is followed, and there must be both a high voltage and a low voltage set of bus-bars. That is, one group of switches must connect generators with low-tension bus-bars, another group must connect low-tension bars with the primary coils of transformers, a third group joins the secondary coils of transformers with the high-tension bars, and the fourth group of switches joins the transmission lines to the high-tension bus-bars. As long as switches were not available to break circuits of large power at the voltages of transmission there seemed to be no escape from the four groups of switches just mentioned. These switches connecting the secondary coils of step-up transformers to the high-tension bus-bars and also the transmission lines to these same bars have often been of the simple open air type with short knife-blade construction. These switches have been used to disconnect the secondary coils of transformers and also the transmission lines from the high-tension bus-bars when no current was flowing, and switches of the simple knife-blade construction with short breaks could of course be used for no other purpose. With switches of this sort on the high-tension side of apparatus the practice is to do all switching of line circuits on the low-tension side.

It is possible, however, to avoid some of this complication and multiplication of switches if each generator with its transformers is treated for switching purposes as a unit and the switching for this unit is done on the secondary or high-voltage side of the step-up transformers. The adoption of this plan, of course, implies the use of switches that are competent to break the secondary circuit of any group of transformers under overload conditions and at the maximum voltage of the system, but oil switches as now made are competent to meet this requirement. When all switching of line circuits is confined to those of high voltage there is also the incidental advantage that heavy contact parts carrying very large currents are avoided in the operating switches. Where each generator is connected directly to its own group of transformers the secondary coils of these transformers will pass through oil switches to high-tension bus-bars, and the use of low-tension bus-bars may be avoided. From these high-tension bus-bars the transmission

lines will pass through oil switches, so that on this plan there are only two sets of main switches, namely, those connecting the secondary coils of transformers and the transmission lines to the high-tension bus-bars, that are concerned in the operation of the generating station. Each group of two or three transformers, according as two or three are used with each generator, should be connected to its generator through short break, open air knife switches for convenience in disconnecting and changing transformers that are not in operation, but these switches are not intended or required to open the circuits of the generators and primary coils when in operation.

A plan similar to that just outlined was followed at the station of the Independent Electric Light and Power Company, San Francisco, where each of the 550-volt generators is ordinarily connected directly to the primary coils of two transformers that change the current from two-phase to three-phase and then deliver it through oil switches to the high-tension bus-bars at 11,000 volts. To these bus-bars the 11,000-volt feeders for five substations are connected through switches. At this station there is a set of 550-volt bus-bars to which any one of the generators may be connected, but to which no generator is connected in ordinary operation. The generators alone have switches connecting with these bars. When it is desirable to operate any particular generator on some pair of transformers other than its own, that generator is disconnected from its own transformers and connected to the 550-volt bus-bars. The generator, whose transformers are to be operated by the generator before mentioned, next has its switch connected to the 550-volt bus-bars, while the brushes of the contact rings of the former generator are raised. As the leads from each generator to its two switches are permanently joined, the switching operations just named connect the transformers of one generator with the other generator that has its switch closed on the 550-volt bars.

Where it is desired that a single reserve transformer may be readily substituted for any one of a number of transformers in regular use, the connections to each of these latter transformers may be provided with double-pole double-throw knife switches on both the primary and secondary sides, so that when these switches are thrown one way at any transformer in regular use the reserve transformer will be connected in its place. The result of the experiments with oil switches at Kalamazoo is confirmed by the regular use of such switches on the 40,000-volt transmission lines at the Colgate power-house in California.

Development of the World's Steel Industry.

The *Deutsche Industrie Zeitung* says that of all the countries producing steel in 1902 the United States led, with an output of 15,000,000 tons. These figures grow in importance when it is remembered that the world's production in 1894 was only 12,851,000 tons. Germany's production in 1902 was 7,780,000 tons, one-half that of the United States; while England's was only 5,000,000 tons, or one-third the production of the United States. The world's total steel output for 1902 was estimated at 35,000,000 tons. This would indicate a growth of 700 per cent in twenty-two years, or an increase from a little more than 4,000,000 tons in 1880 to 35,000,000 tons in 1902. The great increase is due to the introduction and improvement of the processes, notably the flame furnace. Pennsylvania leads all parts of the world in the use of this furnace, followed by Illinois, New England, Ohio, etc.

The steel produced by the Bessemer process during the last fifteen years was used mostly for rails. In England more than half of the steel produced by the Bessemer process went into rails. In Germany and the United States the proportion is not so large. While the United States produced 9,306,471 tons of steel ingots in 1902, it turned out only 2,876,293 tons of steel rails, or about thirty per cent of the steel-ingot production. In Germany the amount of Bessemer steel put into rails is proportionately smaller. Because of the resisting power of the steel, the wear and tear on the rails is far less; but the manifold uses to which the steel can be put has taken away somewhat from the importance of steel-rail manufacture. The last twenty years has resulted in an age of steel. Three times as much steel is now produced as in 1894. The universal opinion seems to be that the production of steel is to go on increasing. If, during the next twenty years, the same rate of increase is maintained as marked the past, 1923 will see an advance of from 20,000,000 to 25,000,000 tons in the world's total production. In this enormous increase the United States, according to experts, is to play the important part. At the very least, this opinion seems reasonable. The United States now uses in a year 30,000,000 tons of the very best iron ore. In twenty years this would mean a total of 600,000,000 tons—possibly the exhaustion of the sources of supply.

The American Street Railway Association.

The twenty-second annual meeting of the American Street Railway Association will be held at the Grand Union Hotel, Saratoga Springs, N. Y., Wednesday, Thursday and Friday, September 2, 3 and 4, 1903.

Papers will be presented on the following subjects:

"Electric Welded Joints."

"The Evils of Maintenance and Champerty in Personal Injury Cases."

"Train Orders and Train Signals on Interurban Roads."

"Freight and Express on Electric Railways."

"The Manufacture and Distribution of Alternating Currents for City Systems."

"Comparative Merits of Single and Double-Truck Cars for City Service."

"The Right of Way."

An extensive exhibit of street railway supplies will be made at the hotel headquarters.

The annual banquet will be held on Friday evening, September 4, when the officers-elect will be installed.

The headquarters of the association will be at the Grand Union Hotel. Other hotels are the United States, American-Adelphi, Congress Hall, Worden and Kensington.

Railroad rates will probably be as in former years.

Electric Tramway in Spain.

Consular Agent A. E. Carleton, of Almeria, calls attention to a concession to be granted for the building of an electric tramway between Mondariz and Porvino. A second section is to be constructed later. This will extend the line to Vigo. The entire length is to be twenty-three miles, almost equally divided between the two sections. The first is to be 10.5 miles; the other, 12.5 miles. The electric power is to be obtained and transmitted from two waterfalls on the River Tea, between Mondariz and Puenta Areas, and from a waterfall on the River Mino, about 15.5 miles from the middle of the line. The force at the first falls is 268 horse-power at the axis of the turbines, and of the second 1,375 horse-power. As the road requires only 375 horse-power, the balance will be used by various industries in the enterprising town of Vigo. The consular agent also reports that another electric tramway is to be built at Linares. It would seem as if every mountain land on earth is looking toward a time when its waste waters can be worked up into electrical force or power for industrial, transportation and all kinds of commercial purposes.

The Recently Installed Saut-Mortier Electrical Power Transmission Plant in France.

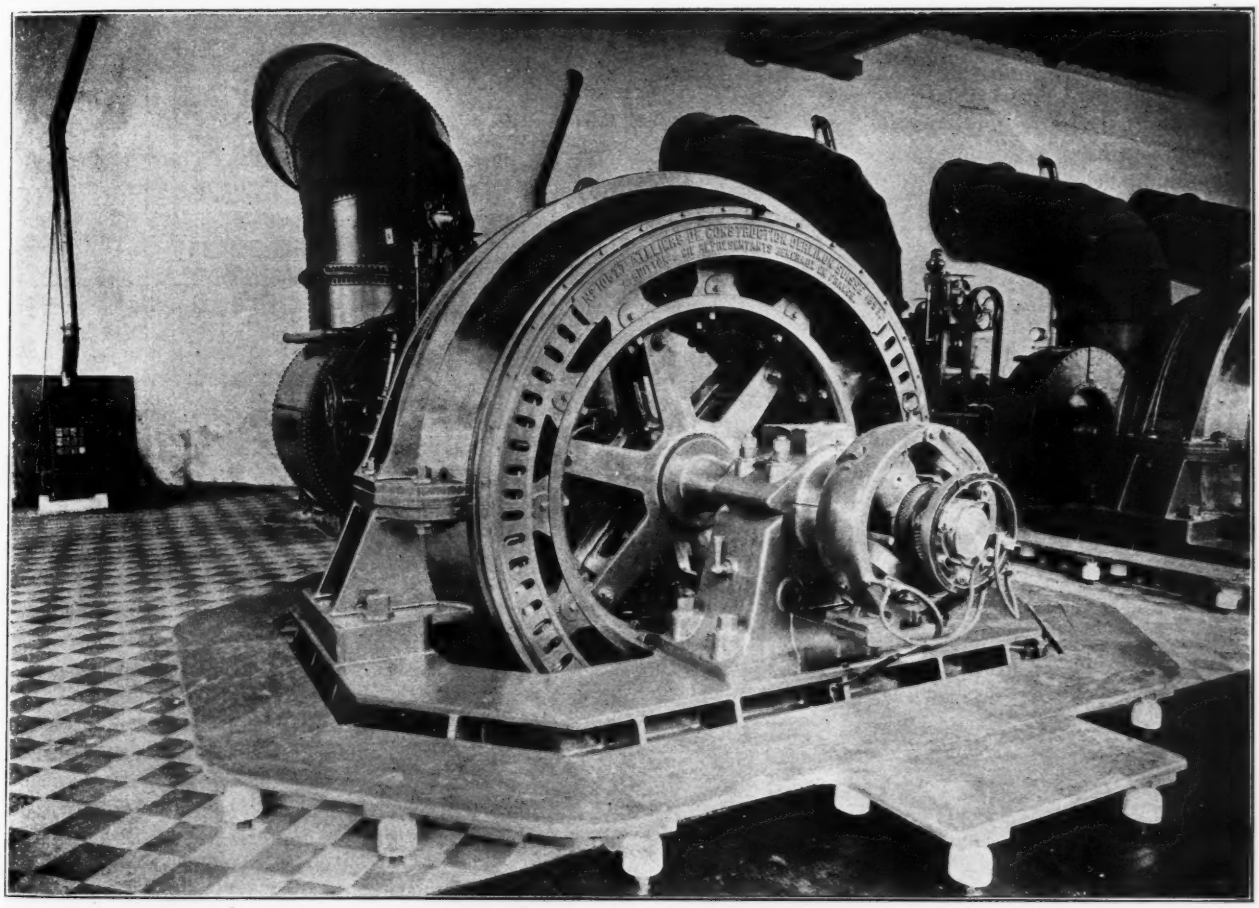
By Frank C. Perkins.

THE Jura is one of the industrial sections of France, and electrical power is utilized to a great extent in connection with the factory work at St. Claude. There is a transformer substation located at St. Claude, which is connected by a power transmission line with the hydroelectric station at Saut-Mortier. The water power is obtained from the River Ain, which rises in the Jura, flowing through that section as well as the Ain, and emptying into the River Rhone. The ordinary flow available from the River Ain is somewhat more than four cubic metres per second, while during high water it rises to about seven cubic metres per second.

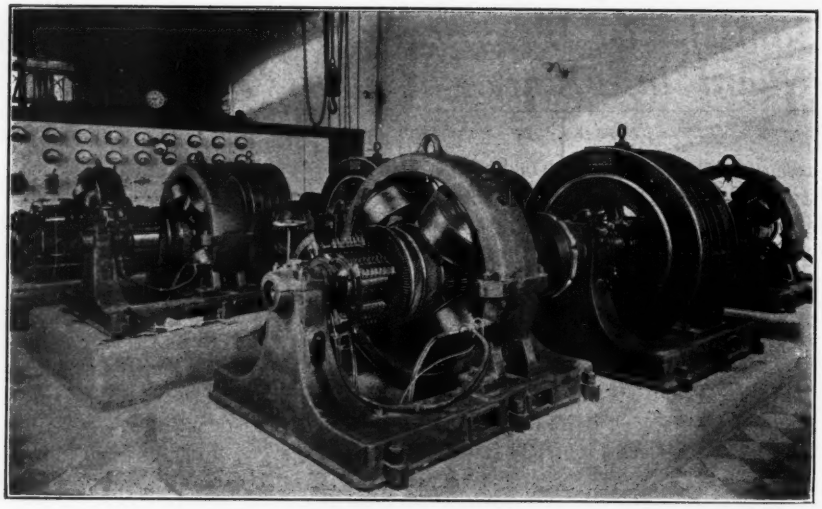
The accompanying illustrations show the exterior and interior of the power-house at Saut-Mortier, which was equipped with electrical generator and switchboards by Maschinenfabrik Oerlikon. Advantage is taken of the Lac de Chalain as a reservoir for the water, which provides a reserve of about 20,000,000 cubic metres. The normal discharge is sixteen cubic metres per second, which gives a total of 3,000 horse-power with a fall of 18.4 metres and 2,500 horse-power with a fall of 13.4 metres. The water is conducted to the power-house through a canal 1,500 metres in length and enters the entrance canal at the power-house, which is forty-five metres in length, the weir being ten metres high. There are three sluices, each one metre in height and 1.78 metres in width, connecting with the canal, which is 234 metres in length and eleven metres wide, with a fall of one to twenty-five. The double supply pipes are constructed of steel eight millimetres in thickness and 1,700 millimetres in diameter.

The power-house has a total length of 34.8 metres, while it is 14.5 metres in width, and has a capacity for four units. The turbines are four in number, and each has a capacity of 700 horse-power when operating at a speed of 250 revolutions, and a head of 18.4 metres. These turbines will develop 500 horse-power under a head of 13.4 metres. They are connected to the electrical generators through elastic insulating couplings of the Rafford type. The turbines are equipped with regulators of the system Piccard, which are said to be very close in the governing of the machines.

The electrical generators are of the Oerlikon three-phase type, supplying a current of fifty amperes per phase, at a potential of 7,500 volts. The frequency is fifty periods per second, when the machines are operating at 250 revolutions per minute. The diameter of the field magnet is 1,870 millimetres, the breadth being 920 millimetres. The two parts of the field coil are each wound with eighty-three turns of copper, bound 60 by 2 millimetres and the two coils are connected in series, making a total of 166 turns. The copper of the field magnet weighs



SAUT-MORTIER POWER PLANT, 700-HORSE-POWER TURBINE AND ALTERNATOR.



Motor-Generator Sets in St. Claude Transformer Substation.

1,250 kilogrammes. The enclosing frame of the machine has twelve openings for ventilation, and has an exterior diameter of 309 millimetres and a total width of 900 millimetres, while the interior diameter is 2,540 millimetres.

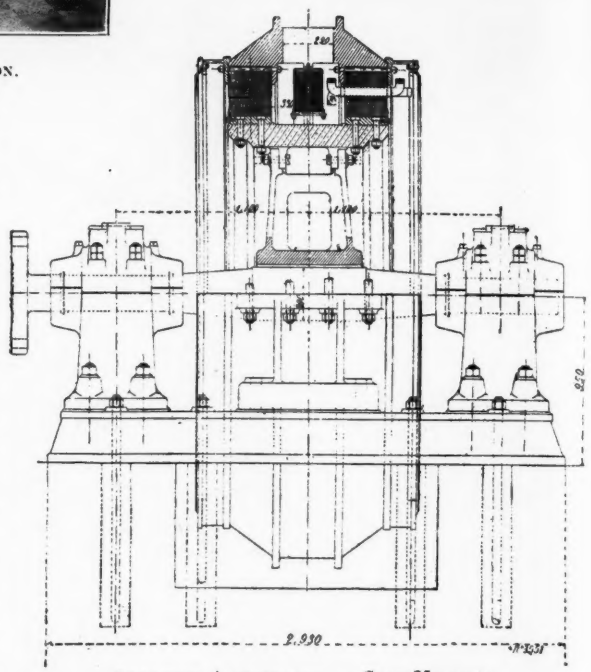
The outer diameter of the armature core is 2,540 millimetres, the rings being 170 millimetres in width. The armature is 250 millimetres in width, and each of the two halves has seventy-two slots, two per pole and phase in which the coils are placed, with mica insulation. Each coil consists of thirty-three turns of two diameters in parallel, each 3.2 millimetres in diameter. The copper of the armature weighs 600 kilogrammes, while the total weight is 1,500 kilogrammes. The normal working current is fifty amperes per phase and a power-factor of 0.8.

The efficiency at normal load and cos. $\phi = 0.8$ is 93.5 per cent. The exciting machines have a capacity of 3,600 watts at a parallel of 300 volts, and are of the four-pole shunt-wound type of drum winding.

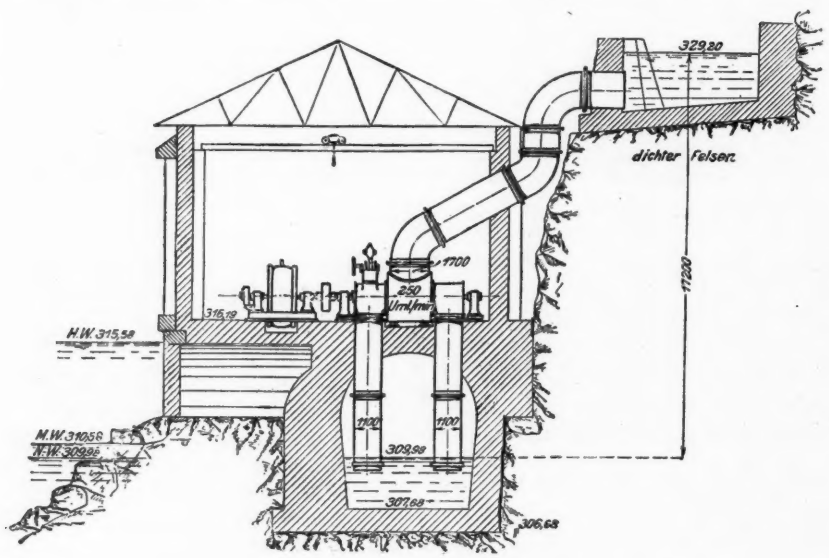
The switchboard gallery of the main power station at Saut-Mortier is 6.7 metres long and 4.28 metres high, the inner height below the gallery being 2.8 metres. The switchboard proper consists of a number of marble panels 2.25 metres in height; the total length of the board being 4.5 metres. The switchboard framework, as well as that of the gallery, is of steel and iron, the flooring being of cement. The rheostats, lightning arresters, fuses and bus-bars are located in a room under the switchboard gallery, and the various ammeters, voltmeters and other measuring instruments, together with the controlling apparatus, are placed on the upper gallery.

The high-tension power transmission lines from the power station at Saut-Mortier to the substation at St. Claude are twenty-six kilometres in length. Two transmission lines are installed, each consisting of three conductors, each having a diameter of eight millimetres. Another transmission line connects the power station with the town of Montau, which is nine kilometres in length, and consists of three wires having each a diameter of eight millimetres. To this line other branch lines are connected of four and six-millimetre conductors supplying current to Oyonnax, Belignat, Montreal and Marchon. The high-tension transmission line from the power-house to Arinthod is eight kilometres in length, while those to Cernon and Morian are five kilometres and ten kilometres, respectively, each of the three conductors measures four millimetres in diameter.

The total length of the high-voltage power transmission lines is 105 kilometres and all of the receiving stations are connected with the power-house by telephone lines, the two wires of which are two millimetres in diameter. The total number of poles used was 3,940, measuring nine, ten and twelve metres



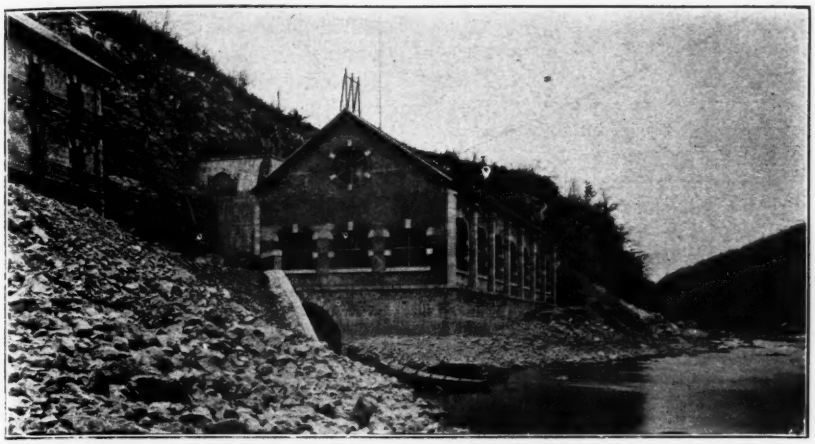
Oerlikon Alternator at Saut-Mortier Power-House.



Turbines and Generator, Saut-Mortier Power-House.

in length, the poles being placed from 1.4 to two metres in the ground.

On the transmission line to St. Claude there is a transformer located in the station at Jeurre, while in the substation at St. Claude there are four transformers each of seventy kilowatts, and further on in the city there are five other transformer installations. The accompanying illustration shows the St. Claude substation which has a floor area of 186 square metres. It is equipped with a seven-ton crane for handling the various machines, making up the motor-generator sets.



SAUT-MORTIER HYDROELECTRIC POWER STATION.

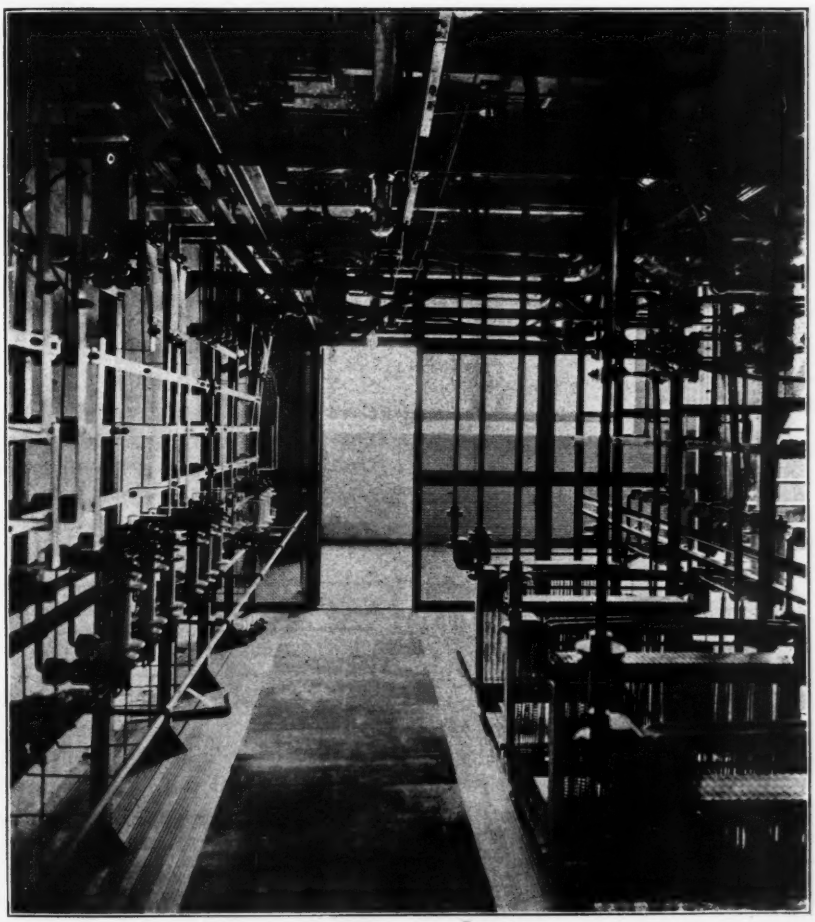
The three-phase motors driving the motor-generator groups are ten-pole Oerlikon machines, each having a capacity of 150 horse-power. They operate at a speed of 590 revolutions per minute, and are supplied by a low-tension three-phase current at 200 volts from the step-down transformers, the frequency being fifty periods per second. The stators are 800 millimetres internal diameter and measure 230 millimetres in width. They are provided with 150 slots, with fourteen parallel copper conductors measuring 3.8 millimetres in diameter. The rotor has an outside diameter of 898 millimetres and has 180 slots, in each of which there are six parallel copper conductors four millimetres in diameter.

Each three-phase motor is directly connected to two direct-current dynamos, one on either side, each having a capacity of seventy-five horse-power. These machines operate at 590 revolutions per minute, supplying a continuous current of 200-volt pressure. The armatures of these machines are 470 millimetres in diameter, and the iron core measures 320 millimetres in width. Each armature has 117 slots of a section, 6 by 30 millimetres, and in each slot there are two conductors, each of which consists of three parallel wires four millimetres in diameter. The commutators of these direct-current machines have each 117 copper segments. The inside diameter of the magnetic field measures 486 millimetres. There are four field-magnet coils, each having 2,450 turns of wire having a section 1.8 by 2.2 millimetres.

The switchboard equipment of the substation at St. Claude is divided into two parts, the one for the high-tension apparatus and the other for the low-tension switches, meters, rheostats, etc.

The low-tension power distribution circuits are operated at a potential of 200 volts on the three-phase lines, the motors varying in size from one-half to thirty-five horse-power each. There are a total of eighty-five three-phase motors working in the various factories, with an output of 684 horse-power.

The arc and incandescent lighting in St. Claude is operated both on the 200-volt, three-phase distribution circuits and also on the 120-volt direct-current lines. In St. Claude there are 3,200 incandescent lamps in operation, with a total of 36,000 candle-power. In the other villages along the transmission lines there are 2,000 incandescent lamps employed on the three-phase low-tension circuits, having a total of 23,500 candle-power.



REAR OF SWITCHBOARD, SAUT-MORTIER POWER PLANT.

Where it is desired to employ water power and a large volume is easily obtainable under comparatively low head, a turbine wheel will be found efficient. High heads and less volume are usually sought, but not always readily obtainable. The relative cost of installation depends entirely upon the surroundings, character of stream and other factors.

POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

R. B. WILLIAMSON.

(Concluded.)

POWER MEASUREMENT IN TWO-PHASE CIRCUITS.

The ordinary two-phase circuit employs four wires, as shown in Fig. 4, and is equivalent to two single-phase circuits so far as power measurement is concerned. A wattmeter is inserted in each circuit and the sum of the two readings gives the total power supplied. If it were certain that the loads on the two phases were exactly alike, both as to amount and power-factor, it would be sufficient to measure the power on one phase and multiply the result by two. Unfortunately this can not be done in the majority of cases, and if only one wattmeter is at hand the best plan is to keep the load constant between readings and shift the wattmeter from one side to the other, either by means of a special switch or by changing the connections. Fig. 5 shows the same connections for a three-wire two-phase system where the middle wire acts as a common return for the two outer wires. The potential coils are here connected to the middle wire instead of as shown in Fig. 4, but otherwise the connections are the same.

Fig. 6 shows a method of measuring the power on a three-wire two-phase circuit with a single wattmeter. This method can only be used where the load on the two phases is balanced, hence it is not always applicable. In Fig. 7, let the lines $o\ c$ and $o\ d$ represent the equal currents in the outside lines; since these currents differ in phase by ninety degrees, their resultant will be represented by $o\ e = I\sqrt{2}$. The current in the middle wire, *i, e.,* in the current coil of the wattmeter, is therefore represented by $o\ e$. The current II lags behind the electromotive forces EE represented by the lines $o\ a$ and $o\ b$ lag equal angles ϕ, ϕ since a balanced condition has been assumed. A reading of the wattmeter is first taken with the potential coil connected, as shown in Fig. 6, and the connection is then quickly transferred to the other side, as shown by the dotted line; the sum of the two readings gives the total power. The current in the current coil of the wattmeter is $I\sqrt{2}$ in each case. By referring to Fig. 7 it is seen that the current in the wattmeter differs in phase from the electromotive force on one side by $45° + \phi$ and on the other side by $45° - \phi$. Hence on the one side we have $W_1 = EI\sqrt{2}\cos(45° + \phi)$ and on the other side $W_2 = EI\sqrt{2}\cos(45° - \phi)$, and total power =

$$W_1 + W_2 = EI\sqrt{2}\cos(45° + \phi) + EI\sqrt{2}\cos(45° - \phi)$$

$$= EI\sqrt{2}(\cos 45°\cos\phi - \sin 45°\sin\phi + \cos 45°\cos\phi + \sin 45°\sin\phi)$$

$$= EI\sqrt{2}(2\cos 45°\cos\phi),$$

$$\text{but } \cos 45° = \frac{1}{\sqrt{2}} \text{ hence}$$

$$= 2\,EI\cos\phi$$

but $EI\cos\phi$ is the power expended in

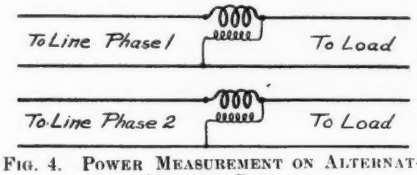


FIG. 4. POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

one phase and $2\,EI\cos\phi$ is the total power, hence for a balanced load the above method of using a single wattmeter will give the total power expended. Note that if ϕ becomes 45° or $\cos\phi = \frac{1}{\sqrt{2}} = .707$, one of the readings will become zero

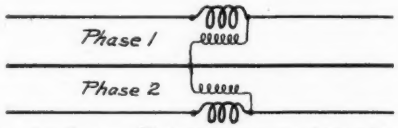


FIG. 5.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

because $\cos(45° + \phi) = \cos 90° = 0$, and the other reading gives the total power which is $W_2 = EI\sqrt{2}\cos(45° - \phi) = EI\sqrt{2}\cos 0° = EI\sqrt{2}$.

Fig. 8 shows another method of using a single wattmeter for measuring the power on a three-wire two-phase circuit. Like the method shown in Fig. 6 it is

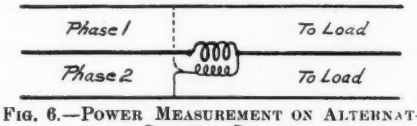


FIG. 6.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

only allowable on a balanced load. In this case the potential coil of the wattmeter is connected across the two outside lines and the current coil is connected in the middle wire. The resultant electromotive force acting as the potential coil is represented by $o\ f$, Fig. 7. The value of this electromotive force is $E\sqrt{2}$. The current in the current coil is $I\sqrt{2}$ as in the last case, and the angle between the resultant current and resultant electromotive force is the same as the angle of lag ϕ in each phase as can be seen by referring to Fig. 7. The reading of the wattmeter is therefore $I\sqrt{2} \times E\sqrt{2} \times \cos\phi = 2\,EI\cos\phi$. That is a single wattmeter connected as shown in Fig. 8 reads the total power, provided the load is balanced. This method does not require the shifting of any connections, but the potential coil of the wattmeter must be able to stand a pressure $\sqrt{2}$ times as great as the pressure on either phase. On a two-phase system the angle ϕ may be different on the two phases, hence, unless the load is perfectly balanced it could not be said that the power-factor was equal to $\cos\phi$. The power of factor of the load as a whole would, however, be the ratio of the total actual watts as obtained from the wattmeter readings to the total voltamperes as obtained from voltmeter and ammeter readings taken on each phase.

THREE-PHASE MEASUREMENT.

The power supplied to a three-phase receiving device or circuit can be measured with either one, two or three wattmeters. Accurate results can not be obtained with one wattmeter unless the load is balanced on all three phases. Of course one wattmeter could be used if means were provided for changing the connections rapidly, and the load kept constant while the readings are being taken, but in many cases it is inconvenient to do this. Three wattmeters can be used, but as two are sufficient to measure the power no matter how unbalanced the load may be, three wattmeter methods are not generally adopted. We will, however, first consider three wattmeter methods as they lead up to the single wattmeter and two wattmeter methods. Suppose in Fig. 9 that A represents a three-phase Y-connected motor, the power consumption of which is to be measured. If a wattmeter current coil is connected in each main, as shown, and the potential coils connected across corresponding phases, it is evident that wattmeter 1 measures the power supplied to phase 1, wattmeter 2 to phase 2, and wattmeter 3 to phase 3. Hence the total power supplied is the sum of the three wattmeter readings whether the load be balanced or unbalanced, or whether the power-factor be high or low. Evidently, if the load were the same on all three phases and the angle of lag the same, *i. e.,* if the load were exactly balanced, it would be sufficient to use a single wattmeter and multiply the reading by three.

In many cases it would not be possible to get at the neutral point k, Fig. 9, in order to connect the potential coils and thus impress on each coil the voltage of a single

phase. An artificial neutral may, however, be obtained, as shown in Fig. 10, by connecting three non-inductive resistances across the circuit. If the potential coils of the three wattmeters are exactly alike the auxiliary resistance may be omitted and the ends of the potential coils joined together, as indicated at the neutral point of the auxiliary resistance in Fig. 10.

The most common method of making three-phase power measurements is by means of two wattmeters connected as shown in Fig. 11. The receiving circuit may be balanced or unbalanced, and be connected Y or Δ. Take the instant when the currents in lines *a* and *b* are in the positive direction, which we will assume is toward the right as represented by the arrows on lines *a b*. Then the instantaneous currents i_1, i_2, i_3 in the three receiving circuits will be as shown by the

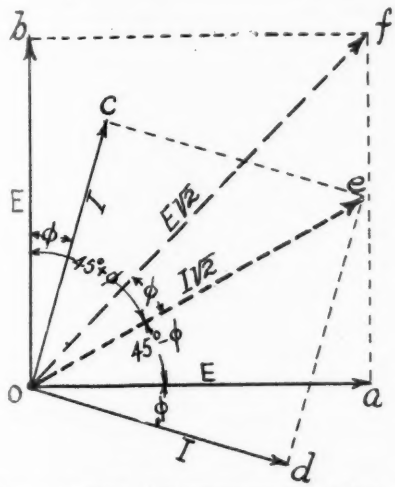


FIG. 7.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

arrows, wire *c* acting as the return for wires *a* and *b*. The electromotive force acting on the potential coil of wattmeter 1 will be directed as shown by the arrow e_1 and that acting on the potential coil of wattmeter 2 will be directed as shown by the arrow e_2. The current in main *a*, and hence in the current coil of wattmeter 1, will be at this instant ${}^{i}a = i_1 + i_3$. We also have $i_2 = {}^{i}b + i_3$ or ${}^{i}b = i_2 - i_3$.

These currents can be added as indicated, because they are instantaneous values. Now the reading of wattmeter 1 is the average value of all the products of the instantaneous current ${}^{i}a$ which flows through its current coil into the instantaneous values of the electromotive force e_1 which acts on its potential coil. Hence, if W_1 is the reading of wattmeter 1, we have

$$W_1 = \text{average } {}^{i}a\ e_1$$

and $W_2 = \text{average } {}^{i}b\ e_2$

but ${}^{i}a = i_1 + i_3$ and $b = i_2 - i_3$, hence $W_1 = \text{average } (i_1 + i_3)\ e_1$ and $W_2 = \text{average } (i_2 - i_3)\ e_2$. The sum of the readings $W_1 + W_2 = \text{average } e_1 i_1 + \text{average } e_2 i_2 + \text{average } (e_1 - e_2)\ i_3$.

Now from Fig. 11 it is seen that the difference between e_1 and e_2 is equal to e_3,

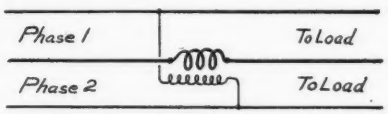


FIG. 8.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

the instantaneous electromotive force between *a* and *b*, hence we have

$$W_1 + W_2 = \text{average } e_1 i_1 + \text{average } e_2 i_2 + \text{average } e_3 i_3$$

that is, the sum of the two wattmeter readings gives the total power supplied to the three receiving circuits.

It is necessary, however, in taking the sum of these readings to pay due attention to the sign of the readings because under certain circumstances the reading of one of the wattmeters must be considered as negative and the numerical difference of the readings taken in order to obtain the actual watts.

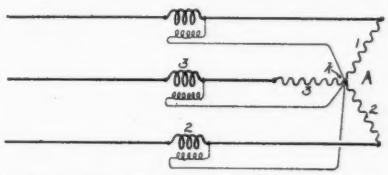


FIG. 9.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

If the load were non-inductive and balanced, the currents in the wattmeter current coils would be in phase with the Y electromotive forces of the system. For example, in Fig. 12, if *o a*, *o b* and *o c* represent the three electromotive forces between the three lines and the neutral point of the system, then the currents in the lines would be in phase with these electromotive forces on non-inductive load. But the coils of the wattmeters are not connected between each of the lines and the neutral point as in Fig. 9. They are connected across the lines and consequently, even on non-inductive load, the current in the potential coil is not in phase with the current in the current coil. The electromotive

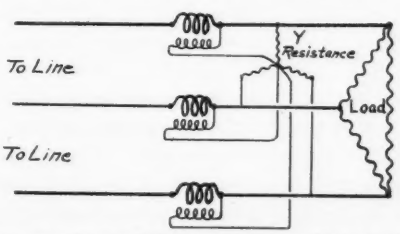


FIG. 10.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

force impressed on potential coil 1 is $o\,a - o\,c = o\,d$, Fig. 12, and that impressed on potential coil No. 2 is $o\,b - o\,c = o\,e$, or on non-inductive load, the pressure applied to coil 1 is thirty degrees behind the current and that applied to coil 2 is thirty degrees ahead of the current. If E is the pressure per phase, *i. e.*, the pressure between each line and the neutral point, then the pressure between the lines, represented by *o d* or *o e*, is $E\sqrt{3}$. Now if we have a balanced load with power-factor less than one the three currents will be no longer in phase with the Y electromotive forces, but will lag by an angle ϕ

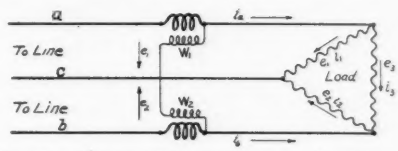


FIG. 11.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

in each phase as shown in Fig. 12 by the dotted lines *o f*, *o g*, *o h*. The phase difference between the currents in the coils of wattmeter No. 1 then becomes $30° - \phi$ and in No. 2, $30° + \phi$. The indication of wattmeter No. 1 will be $W_1 = \sqrt{3}\ EI \cos(30° - \phi)$ and of No. 2 $W_2 = \sqrt{3}\ EI \cos(30° + \phi)$. Now if $\phi = 0°$, power-factor = 1, the wattmeters read alike and each indicates half the load. If ϕ becomes sixty degrees, *i. e.*, power-factor = 0.5 cos $(30° + \phi) = 0$ and the total power is indicated by one wattmeter. If ϕ is greater than sixty degrees, *i. e.*, power-factor less than 0.5, cos $(30° + \phi)$ becomes negative and the difference in the readings of the wattmeters must be taken. If ϕ becomes ninety degrees the readings of the two meters are again alike, but one is positive and the other negative, hence the total power is zero. This is as it should be, because, evidently, if the angle of lag is ninety degrees in each phase no power is being expended.

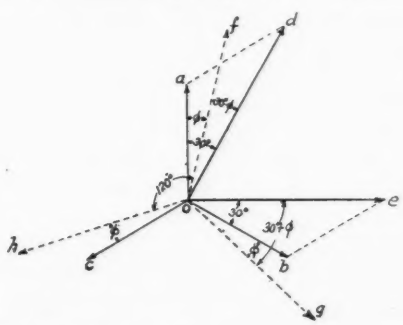


FIG. 12.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

Sometimes it is difficult to tell whether or not the power-factor of the load is less than 0.5, and whether the sum or the

difference of the readings should be taken. Generally, the character of the load will give an approximate idea as to the value of the power-factor, but if there is any doubt on the matter a bank of lamps or other non-inductive load can be attached and the reading of the wattmeter noted. If when this load is replaced by the inductive load, without changing the relative connections of the wattmeters, one of the wattmeters tends to read backward, it shows that the power-factor is less than 0.5.

For a balanced load it has been shown that the readings of the meters are $W_1 = \sqrt{3}\ EI \cos(30° + \phi)$ and $W_2 = \sqrt{3}\ EI \cos(30° - \phi)$, where I is the line current and E the Y voltage, or $\sqrt{3}\ E$ the voltage between any two lines. The sum of the readings $W_1 + W_2 =$

$$\sqrt{3}\ EI(\cos 30° + \phi) + \cos(30° - \phi)$$
$$= \sqrt{3}\ EI(\cos 30° \cos\phi - \sin 30° \sin\phi + \cos 30° \cos\phi + \sin 30° \sin\phi)$$
$$= \sqrt{3}\ EI(2 \cos 30° \cos\phi) = 3\ EI,$$

since $\cos 30° = \frac{\sqrt{3}}{2}$. In other words, the sum of the readings is three times the power expended in each phase, and hence gives the total power. This affords another proof that the sum of the two wattmeter readings gives the total power. The former method of proof used instantaneous values of currents and electromotive forces, whereas this method uses virtual or effective values and takes into account the phase relations existing in the wattmeters, assuming that the power-factor is the same in the three phases.

A method of using a single wattmeter for three-phase power measurement is shown in Fig. 6, if we consider the three lines to be those of a three-phase system instead of a three-wire two-phase system as indicated in the figure. A reading is taken with the potential terminal first connected to one outside wire, as shown by the full line. The connection is then transferred, as shown by the dotted line. In one position the meter gives a reading $\sqrt{3}\ EI \cos(30° + \phi)$ and in the other $\sqrt{3}\ EI \cos(30° - \phi)$. This method can be used provided the load is balanced.

In connection with Fig. 11 it should be noted that the readings of the wattmeters vary with the power-factor of the load and that the ratio of the two readings is

$$\frac{\sqrt{3}\ EI(\cos 30° - \phi)}{\sqrt{3}\ EI(\cos 30° + \phi)} = \frac{\cos(30° - \phi)}{\cos(30° - \phi)} = \frac{\sqrt{3}\cos\phi - \sin\phi}{\sqrt{3}\cos\phi + \sin\phi}$$

The same is true of the arrangement in Fig. 6, for a three-phase system if we take the ratio of the readings obtained with the potential coil connected to the two sides. The ratio of the readings depends only on the power-factor, hence by noting the ratio, the power-factor can be determined even if the volts and amperes are not known, assuming of course that we are dealing with a balanced load. For example, if ϕ were sixty degrees we would have

$$\frac{\sqrt{3}\cos 60° - \sin 60°}{\sqrt{3}\cos 60° + \sin 60°} = \frac{\sqrt{3} \times \frac{1}{2} - \frac{\sqrt{3}}{2}}{\sqrt{3} \times \frac{1}{2} + \frac{\sqrt{3}}{2}} = 0.$$

If ϕ were 30°, the ratio would be

$$\frac{\sqrt{3} \times \frac{\sqrt{3}}{2} - \frac{1}{2}}{\sqrt{3} \times \frac{\sqrt{3}}{2} + \frac{1}{2}} = \frac{1}{2}$$

We can then calculate a pair of curves, Fig. 13, one for positive ratios, value of

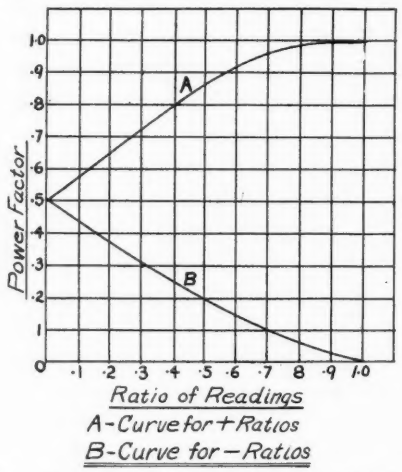


FIG. 13.—POWER MEASUREMENT ON ALTERNATING-CURRENT CIRCUITS.

ϕ less than sixty degrees or power-factor greater than 0.5, and another for negative ratios, values of ϕ greater than sixty degrees or power-factor less than 0.5. By referring to these curves the power-factor of any three-phase load can at once be determined after the ratio of the wattmeter readings is known. The General Electric Company's three-phase power-factor indicator is based on this interesting principle. A fixed current coil is connected in series with one of the wires as shown in Fig. 6 and within it, on a vertical shaft, are mounted two potential coils connected across the sides of the circuit in such a manner that the torques exerted on them are in opposition. This is practically the same arrangement as in Fig. 13, except that instead of shifting the connections of the potential coil, two coils are provided in the same instrument. It is evident that the resultant force acting on the movable coils will vary with the power-factor. Another common type of power-factor indicator is constructed in the same way as an ordinary indicating wattmeter, except that the potential coil has sufficient inductance in series to make the current in the potential circuit lag ninety degrees behind the impressed electromotive force. If such an indicator be connected to a circuit of which the power-factor is one, it will give no deflection, because the current in the current coil will differ in phase by ninety degrees from the current in the swinging coil. If, however, the power-factor of the load is less than one, the currents in the two coils shift more into phase and a deflection results which is to one side of the zero for a leading current and to the other side for a lagging current. The Wagner power-factor indicator is an example of this type.

Indicating and recording wattmeters as designed for commercial use on polyphase circuits often consist of two single-phase meters combined so as to act on a single movable member. Thus these instruments really employ two wattmeters to measure the power as described above, although the two wattmeter elements are combined in a single piece of apparatus.

Gas and Electricity in Spain.

According to the Boletin de la Cámera Oficial de Comercio de Cadiz of March, 1903, the following statistics show the number of gasworks and electric plants in Spain and the amount of taxes collected thereon in the year 1901, the latest year for which statistics have been published:

During the year 1901 there were seventy-nine gasworks in operation in Spain, of which twenty were located in the province of Barcelona. On the other hand, the provinces of Albacete, Avila, Badajos, Caceres, Cuenca, Guadalajara, Huescar, Leon, Lerida, Lugo, Orense, Palencia, Salamanca, Segovia, Soria, Teruel, Toledo, and Zamora and the Canary Islands had none. During the year the production of gas was 136,853,231 cubic metres, which yielded a tax of 2,048,342 pesetas ($395,330).

The electrical plants in operation numbered 961, of which 266 were in the province of Barcelona. The provinces of Huelva and Orense had but two each. The annual production in "hour-kilowatts" reached the figure of 42,248,657, which yielded a tax of 1,955,302 pesetas ($377,383).

Taxes from the manufacture of calcium, 27,834 pesetas ($5,372); customs duties collected on imported calcium, 154 pesetas ($30); taxes from the Basque provinces, 105,180 pesetas ($20,300).

Total taxes collected on gas, electricity and calcium, 4,136,812 pesetas ($798,404).

The Accident in the Subway of the Paris Metropolitan Electric Railway.

On the evening of August 10 a serious accident occurred in the subway of the Metropolitan Electric Railway, at Paris, France. As near as can be definitely established, the essential points in connection with the disaster were as follows: A train coming from Porte Dauphine, at the entrance to the Bois de Boulogne, in the western part of Paris, and passing under the Place de l'Etoile, circled the northerly quarter of the city. In this northern quarter—a manufacturing centre—the train picked up numbers of workmen who were returning to their homes in the populous eastern district of the city. On reaching the neighborhood of the cemetery of Père la Chaise, the motor failed to act properly, and the train waited at the station of Les Couronnes until the arrival of a second train, which pushed the crippled train forward, making a total of sixteen coaches. After proceeding some distance to the Menilmontant station, the damaged motor set fire to the motor car of the first train. This fire was communicated to the ties, which burned fiercely, raising quantities of smoke. By some unfortunate contingency, the electric lighting system of the car was put out of service, leaving the cars and subway in total darkness. This impeded the progress of the train toward the station, and, during a stop, the frightened passengers got out and tried to grope their way back to the Les Courennes station. It was but a short time after the lights went out of service that a panic was in full sway, and this was added to by a third train butting into the burning train and adding another crowd of panic-stricken passengers to those seeking an outlet. It is said that the first intimation that the officials of the road had of the real situation was due to the clouds of smoke rising from the tunnel and a few of the stronger men and women who had been able to make their way through the dense smoke and darkness and staggered out through the station. It was impossible for a long time to approach anywhere near to the burning train, due to the dense volumes of smoke and the fierce heat which were given up at the entrance to the subway. The latest reports state that some one hundred persons lost their lives, due either to coming in contact with the charged third rail or asphyxiation.

The municipality of Paris and the Metropolitan Electric Railway Company combined to relieve the distress of the citizens, as in many cases the head of the home was the unfortunate one to be caught in the disaster.

The accident at Paris has called into prominence every subway system which is in existence or under construction at the present time. Immediately following the accident, the Berlin Council ordered a commission to investigate the conditions existing in the underground roads in and about Berlin, and the commission reported that such an accident as happened at Paris could not take place.

In published interviews, Mr. August Belmont, president of the Interborough Rapid Transit Company, and Mr. E. P. Bryan, vice-president and general manager of the same company, have stated that it would not be possible for such an accident to happen in the rapid transit subway in New York city. The cars to be used will be given thorough fire protection, and the safety appliances to be installed in the subway system are also of such a nature that a repetition of the fatalities taking place at Paris could not be possible. The subway in New York is much nearer the surface than the Paris subway, and the New York system is thoroughly ventilated by manholes, open stations and ample space outside of the cars. Should the wires become short-circuited in the New York subway and start to burn a car, an automatic cutoff would operate, all power between stations where the accident occurred would be shut off, and with the current off the cause of the fire would be removed. Stand-pipes will be situated along the subway, at distances of 100 yards, and connected with fire hose wound on automatically operating reels, so that when the hose is unreeled the full head of water is on. This hose arrangement is called for in the subway construction contract, signed long before the work was begun on the tunnel.

With respect to the cars, they will weigh some 68,000 pounds and will be of asbestos and transite on the floor, while the sides, from the floors to the windows, will be of copper sheeting. The insulation will be carefully carried out by the Interborough company's engineering staff. If the cars are not absolutely fireproof, they will at least be of slow combustion, and provision for shutting off current in the event of accidents and emergency shutoffs will be set at every station. The lighting of the tunnel will be by a separate system to that of the car lighting, and in addition to this an absolute block system is provided for express trains, which is so arranged that there can not be two trains on any one block at a time.

International Conference on Wireless Telegraphy.

The international conference on wireless telegraphy which met in Berlin, Germany, on August 4 occupied itself chiefly in determining those subjects which would be dealt with at the subsequent international conference. To what extent standardization is possible without monopoly will have to be dealt with at a meeting to be held later. The British delegates to the conference were Colonel R. Hippisley, R. E., and Captain H. L. Heath, R. N. Captain Heath has been in charge of the wireless telegraph arrangements on the Vernon for the past year or more. The delegates for Germany were M. Sydow, under secretary of state to the Minister of Posts; Professor Stredkere and Professor Wacheufeld, superior counselors of the Posts Department; M. Schraeder, counselor of the Posts Department, and Captain Scheer, of the Department of the Marine; Dr. Felisch, counselor for the Admiralty; Major Klussmann, commandant of the Aerostatic Park, and Captain Oschmann. The delegates for Italy were Rear-Admiral Grillo, delegated by the Minister of Marine; MM. Cardalii, chief of Department of Posts and Telegraphs, and Soleri, lieutenant of the navy, delegated by the Minister of Posts and Telegraphs.

It is reported that the largest steam turbine in the world is soon to be installed in the Rheno-Westphalian generating station at Essen. It is needed to run a 5,000-kilowatt alternator and a 1,500-kilowatt direct-current generator at the same time. These two machines have been built by the Brown, Boveri Company which then ordered the turbine that must supply 7,500 kilowatts of output to run the two machines. This will no doubt be the largest turbine yet constructed, and the Essen station will thus contain the largest steam-driven generating unit in the world. A turbine of less power, of the same pattern, has been recently tested at Frankfort and its operation proved very satisfactory. According to these results the makers claim that the new turbine will operate with but 15.5 pounds of steam per net kilowatt-hour. The generating unit will occupy much less space than for a steam engine set. The whole set—turbine, alternator and generator—measures fifty-eight feet long but only ten feet wide and the same height; this includes the length of the turbine which measures only twenty-three feet long for a capacity of 7,500 kilowatts. The foundation is disposed so that the group is not at a great height above the ground level, and it can be taken care of from the floor of the station, so that the usual platforms and staircases will be dispensed with.

The New Electric Locomotive for the Baltimore & Ohio Railroad.

The most powerful locomotive in the world has just been built by the General Electric Company at Schenectady for the Baltimore & Ohio Railroad for use in its tunnel underneath the city of Baltimore. This locomotive marks a very distinct advance in electric locomotive design. It will handle all the freight traffic of the B. & O. which passes through Baltimore and will operate over the same section as the present electric locomotives built by the General Electric Company and which have been in successful operation for the past eight years.

In designing this locomotive the specifications called for an electric locomotive capable of handling a 1,500-ton train including the steam locomotive but excluding the electric locomotive on a maximum grade of one and one-half per cent at ten miles per hour with corresponding higher speed on lighter grades. This required a locomotive weighing approximately 160 tons on the drivers for purposes of adhesion and the engineers of the General Electric Company decided that the most practicable scheme was to build an articulated locomotive consisting of two complete eighty-ton units operated together as one locomotive by means of the Sprague-General Electric multiple unit control.

The section of the road to be operated runs from Camden street station through the tunnel to the summit of the grade outside the tunnel, a distance of three and one-half miles.

Under practical operating conditions the motors have sufficient capacity to maintain this service hourly, running loaded up the grade and returning light.

On account of the simplicity and accessibility and minimum number of wearing parts, it is believed that the maintenance account of this locomotive will be very low. All wearing surfaces have been made large for the purpose of ensuring long life. At the same time, special provision has been made for their easy replacement whenever it becomes necessary. There is a large space under the cab floor in which a man can stand and inspect the motors or truck gear.

The whole locomotive consists of eight G. E.-65 motors, four on each half. These motors have each a capacity of 225 horsepower, making a total capacity of 1,800 horse-power.

The main body of the truck frame consists of a rectangular framework of cast steel built up of four pieces, two side frames and two end frames, made strong and heavy. The parts are machined at the ends and securely fitted and bolted together, thus forming a very strong and rigid structure capable of withstanding the most severe shocks without injury.

The end pieces form the buffer beams and to these a suitable standard draft gear of approved design is attached.

The side frames have machined jaws protected by wearing shoes between which the journal boxes slide.

The truck frames are supported at four points on equalizers. Each equalizer rests on a pair of half elliptic springs, the ends of which are supported on top of the journal boxes through suitable wearing plates. This construction forms a simple and effective arrangement of parts.

The journal boxes are made quite similar to standard car journal boxes; the parts, however, are made larger and stronger. The brasses can be easily removed and by dropping down the wearing shoes it is possible to remove a journal box complete without removing the wheels and axles or other parts of the truck.

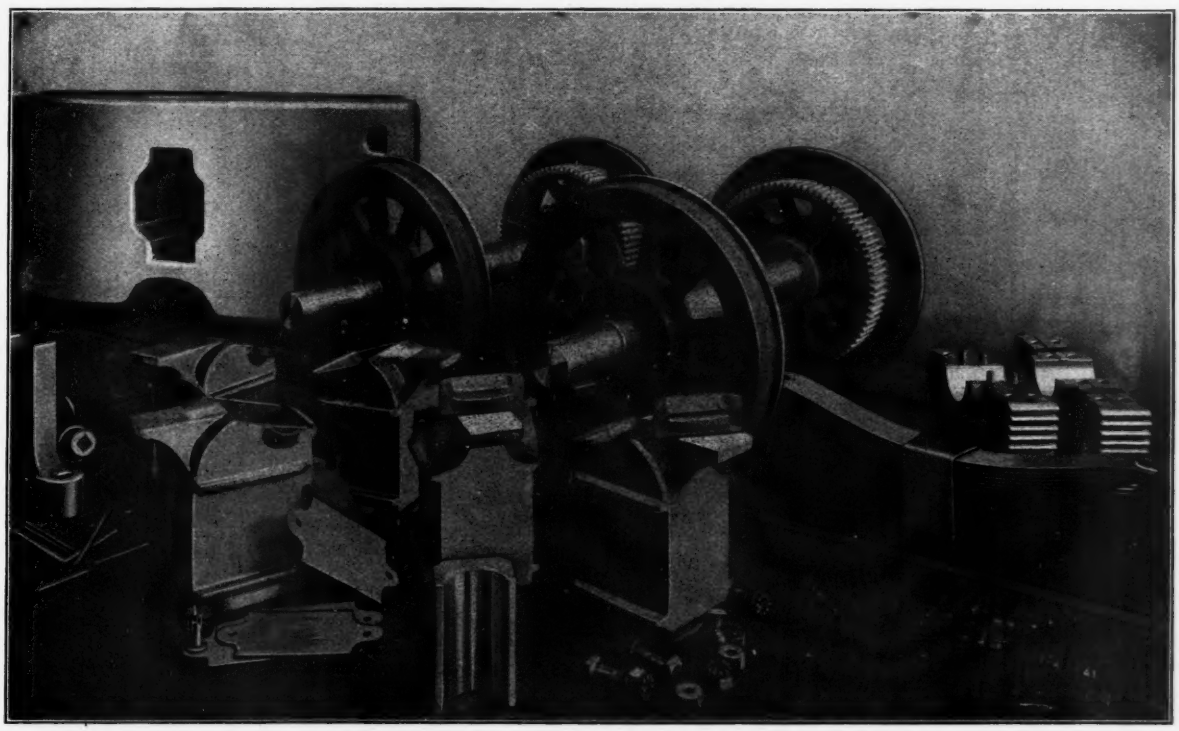
In order that the locomotive may round curves easily, the axles are given considerable lateral movement in the journal boxes, it being practical to do this with this design of electric locomotive and thus reduce the effective rigid wheel base.

Wheels, axles or motors can be easily removed from the trucks by dropping into a suitably constructed pit or by raising the truck frame.

NEW ELECTRIC LOCOMOTIVE, BALTIMORE & OHIO RAILROAD.

Each section of the locomotive has eight steel-tired spoked wheels. The tires are are securely held in place by approved fastenings. The axles are made of forged eight inches in the wheel pit and seven and one-half inches in the motor bearings.

Truck Section, New Electric Locomotive, Baltimore & Ohio Railroad.



Assembly of Truck and Gearing, New Electric Locomotive, Baltimore & Ohio Railroad.

two and seven-eighths inches thick with M. C. B. standard tread and flange and steel turned throughout, six by twelve inches in the truck journal bearings, The cab is large and roomy. The floor rests on the truck frame. The lining

floor is made of one and three-quarters inches hard pine tongued and grooved, the upper floor is of hard pine seven-eighths inch thick, tongued and grooved and laid in the opposite direction from the lining floor.

The sides and roof of the cab are made of sheet steel. On each side there is an entrance door, and at each end there is an additional door which permits of ready communication between sections when coupled together. Large windows afford a practically unobstructed view in all directions.

The controlling apparatus, consisting of master controller, engineer's valves, etc., is in duplicate, a complete set being located in diagonally opposite corners of each cab, so that the engineer, when it suits his convenience, can stand in the front end of the locomotive when running in either direction.

Each section of the locomotive is equipped with one bell, one whistle, two locomotive headlights, approved air brake mechanism, including two engineer's valves and air gauges, necessary brake cylinders, foundation brake, air reservoirs, couplers and draw heads; also with pneumatic track sanders.

Each section of the locomotive is equipped with four G. E.-65 motors and Sprague-General Electric multiple unit control, so arranged as to be able to operate each section independently or two or more sections coupled together.

New Galvanic Battery in Germany.

Consul Oliver J. D. Hughes at Coburg reports that a new German patent relating to galvanic batteries of the dry class has been issued. The improvements cover the production of a battery which is capable of being kept in store, of being transported in an absolutely dry condition, and of being rendered fit for use at a moment's notice by the introduction of a suitable liquid or electrolyte into the separate cells constituting the battery. The object aimed at appears to have been secured by certain novel features of construction and combinations of parts.

The dry cells consist each of a zinc or other metallic cylindrical electrode, and of a carbon electrode having a cylindrical or prismatic cross-sectional area placed within the metallic cylinder. The space between the two electrodes is filled up with blotting-paper or other suitable material capable of absorbing the electrolyte. A plurality of these cells is arranged within a suitable socket or frame-shaped casing, the cells being separated from each other and the surrounding casing by asphalt or other insulating material. When required for use the covers are removed from the cells and filled up with the blotting-paper soaked with any convenient electrolyte, such as ammoniac solution, etc. The covers are then replaced and the battery is ready for use. Insulating rings at the open ends of the cells or zinc cylinders prevent short-circuiting of the cells by any overflowing electrolyte.

Electrical Heater and Ventilator.

A new type of electrical heater and ventilator is described in the current issue of *Revue L'Electricite,* Berne.

There are two disadvantages incident to the use of electric heaters. One is that it takes a relatively long time to heat an entire room, particularly those points at a distance from the radiator, and secondly the heat is not uniformly distributed. These difficulties have induced M. de Mare to investigate the problem of electric heaters and his work has resulted in the following new arrangement: In the first place, to heat a room quickly it requires either a large apparatus or the means of increasing the effectiveness of a smaller apparatus. This can be done by rising its temperature and forcing a current of air through it. Any increase in the size of the apparatus is undesirable, because of the increased expense and also because such an apparatus is usually bulky. M. de Mare avoids this necessity by taking advantage of the increased current which can be passed through a conductor when the latter is surrounded by compressed air. A wire which of ordinary temperature will glow with a surrounding current density and which in rarefied air will burn, when in compressed air it may not even become rared. To make use of this effect, the heating wires are placed within a ventilating fan so that they lie in the path of the compressed air. The apparatus consists of a centrifugal blower carrying nickel wires on the revolving part and in the collecting and discharging duct. The air is drawn through the usual openings near the centre and passes through the wire on the fan and that in the discharging duct. The apparatus is effective, easily regulated, but of course is open to the objection of all the electric heating apparatus that cost of power is generally too high for its commercial success.

A Small German Arc Lamp.

A new type of small arc lamp has been recently brought out in Germany by the Sirius Electric Company, of Leipzig. This lamp, known as the "Piccolo," is designed to compete with the small arcs made by the Schuckert and the Siemens & Halske firms, and is claimed to have some advantages over these. The "Piccolo" measures only twelve inches long and has a globe 3.4 inches in diameter. It is used on direct-current circuits and is designed to give a long run. The regulating device for the arc is very simple. The main solenoid has a core whose lower part clamps the upper carbon. One of the main advantages is that it can be placed directly in 110 to 120-volt circuits without using a rheostat. This result is obtained by a special method of winding the solenoid, and thus a rheostat is dispensed with, giving a considerable economy and simplifying the connections. When the lamps are to be mounted two in series across a 220-volt circuit, this is carried out by using an extra rheostat in the circuit. The new lamp is constructed for two values of current, one or two amperes, and both types will run for ten hours. The method of fixing the globe is somewhat new and has been simplified, as the globe is not held as usual by screws, but is kept in place by a spring, and can be removed and replaced by a simple pressure. The globe is well enclosed and thus the lamp can be used to advantage for outside lighting, where the area to be covered is not too great. For inside lighting, it is arranged to be either hung up or mounted on a support, and on account of its small size can be used along with incandescent lamps in chandeliers. The lamp is made to sell very cheaply, and its price is but thirty-five marks, or $8.75.

American Electrotherapeutic Association.

The American Electrotherapeutic Association will hold its thirteenth annual convention in Atlantic City, N. J., September 22, 23 and 24. A large number of papers has been prepared for reading and discussion by prominent members of the medical profession. It is expected that a very large attendance will be present, and that the discussion will go far to establish the status of electricity in therapeutics.

Electrical Power Installation of the Industrial Works, of Bay City, Mich.

The Industrial Works, of Bay City, Mich., one of the largest manufacturers of railroad wrecking cranes in the world, has recently added to its electrical power equipment four Westinghouse generators and a number of induction motors. In addition to wrecking cranes, the Industrial Works also manufactures smaller cranes and transfer tables.

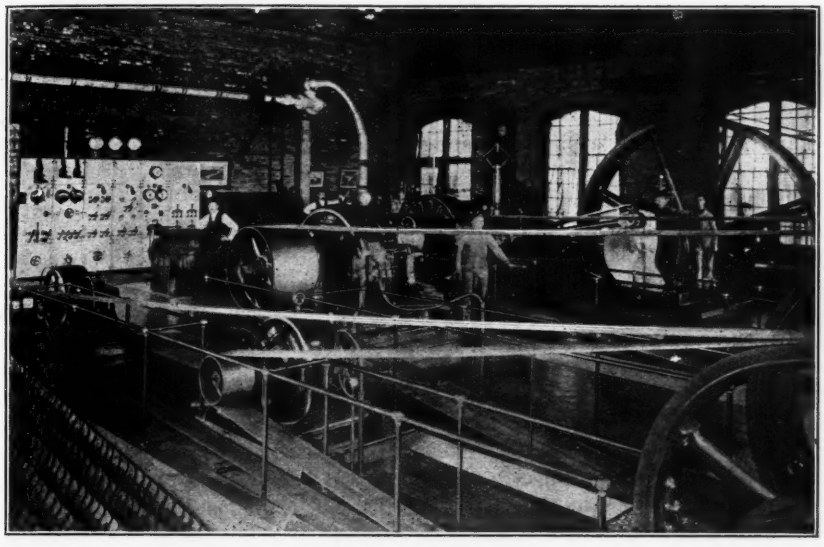


FIG. 1.—MAIN SWITCHBOARD AND ONE OF THE ENGINES, INDUSTRIAL WORKS, BAY CITY, MICH.

The new generators consist of one 150-kilowatt, direct-current, 110-volt multipolar; two thirty-kilowatt, 110-volt multipolar, and one 200-kilowatt, alternating-current, 220-volt, three-phase machine, operating at 7,200 alternations. This combination of machines gives a very flexible power system. The alternating-current machine is used for power purposes entirely; giving the best results for motors located in inaccessible places. The large direct-current generator is also used exclusively for supplying power, and furnishes current for the operation of cranes and transfer tables and testing direct-current motors on cranes. The two thirty-kilowatt, direct-current generators are used for lighting. The switchboard arrangement is such that these two machines may be run either in series or multiple, the latter case being desirable when they are used for testing purposes on a 220-volt circuit.

The distribution of power and light is accomplished by means of distributing switchboards placed in the various shops, these being located at some distance from the power-house.

Communication between power-house and shops is obtained through an underground tunnel, supports being provided in the tunnel for carrying the main feed line. In this manner, while all of the main circuits are controlled from the engine room switchboard, small individual light and motor circuits are at the same time under the control of the foreman in the various shops.

Fig. 1 shows the main switchboard, one of the engines, and other portions of the engine room equipment. The switchboard installation was also furnished by the Westinghouse Electric and Manufacturing Company.

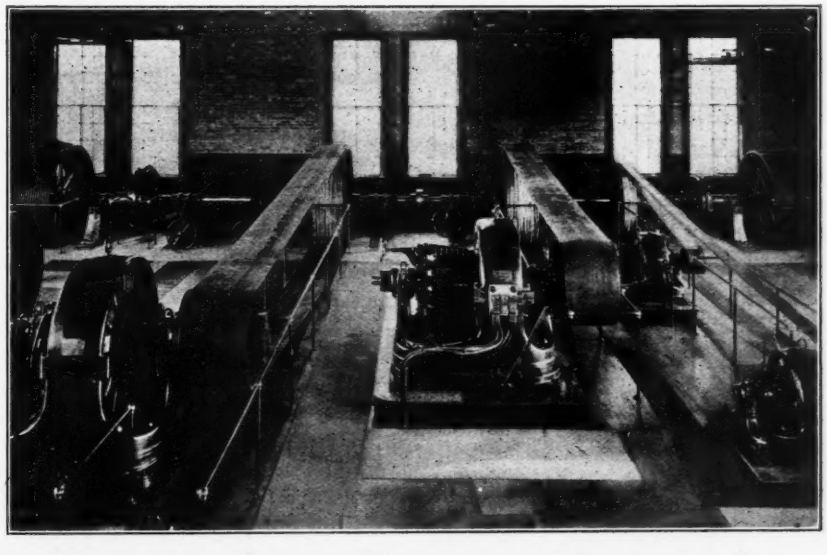


FIG. 2.—INTERIOR VIEW OF POWER-HOUSE, INDUSTRIAL WORKS, BAY CITY, MICH.

Fig. 2 is an interior view of the power-house, showing the four generators and the jack shaft with its connections between engines and generators. The jack shaft with the rope drive, both of which were furnished by the Dodge Manufacturing Company, of Mishawka, Mich., is well shown in Fig. 2. A fact worthy of particular attention is that the shaft may be driven independently or simultaneously from either end, it being possible to cut off either engine by means of the friction clutches, shown in the illustration. Each generator is also furnished with a friction clutch. Furthermore, either half of the shaft may be run separately by removing the plate between the two flanges of the solid couplings, shown in the centre of the shaft. The system shown, while taking a rather large amount of room, is a very flexible one as far as the addition of new machines is concerned, and where room is not a very important item. The Industrial Works considers this arrangement quite as satisfactory as a direct-connected system.

Power is transmitted to the jack shaft by means of two engines, one a 400-horse-power tandem-compound condensing Hamilton-Corliss, connected by rope-drive of the American system. This engine drives the shaft alone, the other engine, a simple Allis-Corliss of 200 horse-power capacity, being held in reserve in case repairs are necessary to the larger engine, or for special work not requiring full amount of power.

Proceedings of the Engineers' Club at Philadelphia.

The June issue of the Proceedings of the Engineers' Club at Philadelphia contains the following papers: "Improvement, Extension and Filtration of the Water Supply of Philadelphia," by John W. Hill; "The Richards Prismatic Stadia as a Range-Finder," by E. K. Landis, "The Obstruction of the Navigation of Southern Rivers by the Growth of the Water Hyacinth," by L. Y. Schermerhorn; "The Military Importance of Naval Engineering Experiments," by Rear-Admiral George W. Melville, U. S. N.

Electrical Notes from Europe.

From Our Special Correspondent.

THE electric tramway system of Marseilles is now one of the most extensive in France. All the tramways in the city now use electric traction with the exception of one line which is operated by a type of steam locomotive. Most of the lines radiate from the central part of the city and pass out to the suburbs. The total length of the lines is about sixty-five miles. The trolley system is used throughout, with a trolley wire of ten millimetres silicon bronze suspended twenty feet above ground by central or side posts. The feeder system is divided into six groups, corresponding to six substations. The central station of Saint Giniez which supplies all of these has been installed by the Société Alsacienne on the three-phase system, using 5,500 volts and twenty-five cycles. From the central station a series of high-tension feeders is laid underground to the substations, where a set of step-down transformers and rotary converters supplies direct current for the line. The central station is a large one and contains four batteries of five boilers each, or twenty in all, provided with Green economizers. The fuel used is English coal which comes by boat and lignite which is found in the region; a mixture of the two is employed. The main dynamo room contains five direct-coupled alternator groups of 1,000 kilowatts each and five exciters of eighty kilowatts. The compound Corliss engines are provided with thirty-six-ton flywheels. The alternators have a fixed armature ring on the outside, in which revolves a forty-pole internal field. The substations have each a bank of step-down transformers and either two or three rotary converters. In two of the substations the converters have a capacity of 225 kilowatts each, and in the remaining four, 400 kilowatts. Each of the substations is provided with a battery of accumulators which acts as a reserve and are capable of supplying the normal current of the substation for one hour. This battery, which is of the Tudor pattern, is used in case of repairs to the machines. The trolley cars which are used on the different lines have twenty-one places inside and twenty-eight on the platforms, or a total of forty-nine places. They are equipped with Thomson-Houston motors and controllers, using three types of motor varying from nineteen to twenty-five kilowatts. The old horse cars are utilized as trailers, and the lighting current is brought by a cable which connects the cars. Spenz electric brakes are used on the trolley cars. The extent of the Marseilles system will be remarked from the fact that the figures for the year 1902 showed a total of 61,180,191 passengers.

Paris now possesses a physical testing laboratory which will no doubt prove as useful in physical work as the electrical laboratory has been to electricians. The latter has been established for a number of years and is under the immediate direction of the Société Internationale des Electriciens. The extensive laboratories on the Rue de Stäel, under the supervision of Professor Janet, are used to standardize instruments and carry out tests upon various electrical apparatus, especially new inventions which it is desired to have tried. The new physical laboratory which has just been installed will work upon similar lines. It occupies extensive quarters in the buildings of the Conservatoire des Arts et Metiers, which is the headquarters for physical work and contains a large museum. The new laboratory has been established by the city of Paris, having received important contributions from the Chamber of Commerce and from different companies and societies interested in the question. It is designed to carry out physical tests, standardizing of apparatus, etc., when desired, and a small fee is to be paid for such work. A fine equipment of apparatus and machines has already been installed. The laboratory is divided into five sections according to the nature of the tests—physical work in general, metals, metallic construction, machines, vegetable matter. The different industries can thus have rough or manufactured products of all kinds tested here in the most efficient manner, as also various machines and devices. An important part of the work will be the calibration of physical instruments. Professor Perot, a leading physicist, is at the head of the new laboratory.

The French Government is shortly to carry out a series of tests upon different aeriel telegraphy apparatus in order to determine the best conditions and types of apparatus for practical working. To this end M. Berard, one of the chiefs of the State Telegraph Department, has decided to erect two wireless telegraphy stations in the neighborhood of Paris. Here different apparatus will be tested and operators will be trained for the government service. The two stations, one of which is located near Melun, will be about twenty-five miles apart.

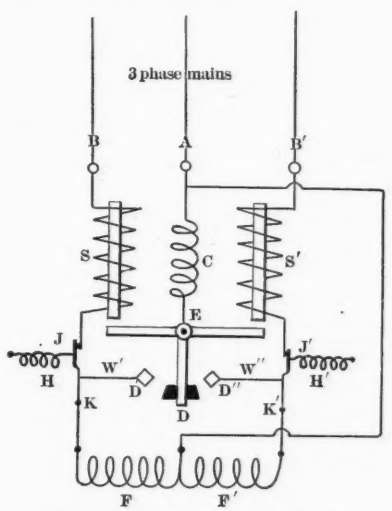
Wireless telegraphy will be used to great advantage in the expedition to the North Pole which is now being organized in Munich by Dr. Scholl. He proposes to erect a station on Spitzbergen Island, which will be laid out on a large scale so as to communicate with the exploring vessels. To this end he has made propositions to the Wireless Telegraph Company and proposes to have the Braun-Siemens & Halske system installed. On board the vessel used by the expedition will be a similar station and it is expected that messages can be sent between the two throughout all the course of the vessel. It is stated that the preliminary tests will be soon made by Dr. Scholl in connection with the Telegraph Company.

It is stated that the Italian Government is soon to carry on wireless telegraphy operations on a large scale, and a station of great power is to be erected in Italy which will not only communicate with the interior and the rest of Europe, but also with South America. The government came to this decision after the recent success obtained by Marconi in sending messages across the Atlantic, and it is now proposed to construct an aerial telegraphy post of especially long range. The Italian Congress voted the sum of 800,000 lire ($160,000) to be used for this purpose. According to a decree which has recently been passed, the station is to be laid out with sufficient power to be able to communicate with a similar station to be erected in South America. It will be utilized besides to communicate with the different Marconi stations in Europe. Marconi himself is to have charge of the work and he acts as the representative of the two English and American companies which hold the patents. According to an agreement between the Minister of Posts and the inventor, Marconi is to be charged with the delivery of all the necessary material for the station and is free to choose the position of the latter as well as the apparatus. The work is to be begun within six months after the date of the agreement

and completed within three years. The post in South America, similar to the former, is to be erected by the British Marconi Company. The station in Italy will communicate with the latter and also with the other stations throughout the globe belonging to the two companies, also with the interior of Italy and the colonies. The government pledges itself to use only the Marconi stations for exchanging messages, except in case of war vessels.

A new form of electric postal wagon lately tried at Milan has met with considerable success. It is used to take the mail from the boxes, stamp it en route and arrange it for distribution, and in this way a considerable saving of time is effected. The wagon which has been built by Turinielli Company has a box body of considerable capacity, with a seat in front for the driver. The inside is fitted up for sorting the mail and has an employé devoted to this work, while the remaining space is reserved for the postman. The wagon is brought to one of the city letter boxes, when the postman descends and takes the mail from the box, passing it to the employé who stamps and sorts the mail according to its destination while the wagon is proceeding to the next box. Each district of the city has an employé who receives the mail from the wagon at specified places and distributes it at once along his mail route, and thus the letters are at once distributed without being obliged to pass through the post office, hence a great saving of time. The wagon has its wheels spaced to standard gauge so that it can travel along the tramway tracks. The two motors of six horse-power, one for each axle, drive it at the rate of four to twelve miles an hour. Suitable controllers and brakes are provided. The new postal wagon was put through a series of trial tests not long ago in presence of the officials and its operation proved quite satisfactory. It is now proposed to extend the system and carry out all the postal distribution in the city of Milan upon this plan.

M. A. Lehotzky, an Austrian engineer, has devised a new automatic cutout apparatus for use with polyphase motors. Supposing a three-wire two-phase motor with the usual short-circuited armature to be running on load, in case one of the field circuits should become broken the armature will burn out if the other half of the field is not cut out by means of its fuse. The fuse in the second circuit will not usually blow out in this case, as these fuses are regulated to stand the heavy starting current of the motor, and there will be no damage to the field circuits, but the short-circuited armature will cease to revolve and burn out. To avoid this possibility a device should be adopted so that in case the fuse on one side of the field should blow or the circuit be otherwise broken the others will follow and the whole field will be cut out. This the inventor accomplishes by a very simple and effective device, whose principle is shown in the diagram. Above are the three-phase mains, A being the common wire and BB′ the outer wires. The middle wire A is connected through a resistance C to a three-branched lever E which can turn about a central pivot. The two side branches are under the solenoids SS′, while the lower branch D can swing to the right or left and thus throw the circuit on the plug D′ or D″. The common wire A is also connected be-



CUTOUT FOR POLYPHASE MOTOR.

low to the middle point of the motor fields FF′ as usual. The side wires are connected to the ends of the field through the solenoids SS′ and the switches JJ′. The solenoids have movable cores which when the current passes are normally held up at the middle point. The switches JJ′ are pivoted about KK′ and are held closed by the fine steel wires W′ and W″, but should these break they will be opened by the strong springs HH′. When the current passes to the motor normally, the parts remain as shown, but should the circuit B, for instance, and in consequence the current in the solenoid S′ become broken, its core will fall and strike the lever arm below it, and the arm D will be thrown over to D′. A current will then pass by AD′ W′ and the steel wire will melt and allow the spring to operate the switch and break the current of the left-hand circuit. In this way both circuits are broken at once and the armature of the motor receives no damage. In this case the middle circuit A does not carry a fuse, as the current must always pass in it.

Electric traction on main railroad lines in Switzerland will no doubt receive a fresh impulse owing to the conference which has been lately held at Berne in order to develop this important question. The conference brought together the presidents of the state and private railroads, together with the directors of the five leading Swiss electrical firms, also the representatives of the Swiss Association of Electricians and other bodies interested in the question. This move is due in the first place to the efforts of M. Tissot, director of the Swiss Electric Company, of Bale, and he first brought out the idea at the general assembly of electrical societies which was held in October, 1901. The proposition was received with favor, and it was recognized that the question should be studied as soon as possible, seeing that it is of such importance for the industrial development of Switzerland, which, although it is completely deprived of coal, is abundantly supplied with hydraulic power. However, to develop the idea properly there should be an understanding between the railroad authorities and the leading Swiss electrical houses in order to bring about the best conditions for utilizing the hydraulic power on existing railroads or in the construction of new lines, so as to unite all the elements which are necessary to bring such a difficult enterprise to a successful conclusion. Accordingly a provisory committee was appointed at that meeting, consisting of leading electrical and railroad men, in order to take the first step in the matter. At last spring's conference the work has been further extended by forming a permanent committee which consists of representatives of the railroad administrations and the leading electrical companies. This committee is to take the matter in hand and will consider what will be the best steps to take in order to apply the hydraulic power upon railroads, and will also lay out a financial project. M. Flury, the president of the state railroads, is at the head of the committee, and Dr. Tissot is vice-president, while the treasury is in charge of Brown, Boveri & Company. Besides, a technical commission will study the different engineering questions relating to the project. By the next meeting the matter will be considerably advanced, and it is probable that most of the Swiss electrical companies will be represented on the committee. Some interesting developments are therefore to be expected in this direction.

C. L. DURAND.

Paris, August 8.

Transformer Data.

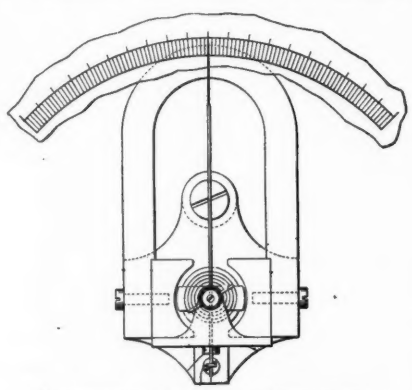
The following table gives the data of a test of one of the transformer groups in the St. Claude substation, Saut-Mortier power station, consisting of an Oerlikon 150-horse-power three-phase motor and two seventy-five-horse-power dynamos. It shows the speed, voltage, current, etc., of the motor, as well as the output of the direct-current machines at various loads, together with the efficiency of these machines.

150 Horse-Power Three-Phase Motor.									Direct-Current Dynamo No. 1.			Direct-Current Dynamo No. 2.				
Revolutions per Minute.	Per. per Second.	Voltage.	Amperes per Phase.	Motor Output—Kilowatts.	Cos.	Slip Per Cent.			Voltage.	Useful Current—Amperes.	Exciting Current—Amperes.	Voltage.	Useful Current—Amperes.	Exciting Current—Amperes.	Efficiency of Group. Per Cent.	Kilowatt Output of Direct-Current Generators.
598	50	205	75	6.0	0.93	0.3			210	....	1.4	....	....	1.4	....	....
608	....	205	84	8.4	0.87	....			210	185	1.59	214	159	1.5	86.5	62.0
607	....	213	900	60.9	0.83	....			206	166	1.47	210	128	1.41	86.8	71.2
587	....	208	975	82.8	0.851	....			210	207	1.75	209	243	1.75	86.8	107.0
585	....	215	385	123.0	0.857	1.9			205	223	2.3	245	178	2.5	....	....
587	....	210	350	....	....	....			245	....	....	....	....	....	....	....

The temperature of the stator of the three-phase motor after operating four and one-half hours at full load was 42.5 degrees centigrade, while that of the rotor was forty-four degrees centigrade and of the stator iron fifty-two degrees centigrade. The armature of one of the direct-current generators reached a temperature of forty-five degrees centigrade and its commutator fifty-five degrees centigrade, while that of the field was thirty-one degrees centigrade. The temperature of the armature of the other machines was fifty-five degrees centigrade, while its commutator was raised in temperature to seventy-four degrees centigrade, and the field to thirty-one degrees centigrade. The temperature of the surrounding air during this test was twenty-four degrees centigrade. As will be noted by the table the efficiency of the entire motor-generator group was 86.8 per cent, with a load of 123 kilowatts on the motor, the two direct-current machines supplying 107 kilowatts.

Electrical Patents.

John Franklin Stevens, of Philadelphia, Pa., has obtained a patent on a new electrical measuring instrument. The principle upon which the instrument depends for its operation is that of the well-known Deprez-D'Arsonval galvanometer, namely, a coil or helix of conducting wire which oscillates between the poles of a permanent magnet. It is well known that if current from any source of electric power be conveyed into and out of a coil of wire when such coil is suspended between the poles of a permanent magnet the coil will tend to deflect until it reaches such a position that the lines of force generated in it due to the passage of the current will coincide in direction with the lines of force generated by the permanent magnet field by which it is surrounded. The extent of movement of

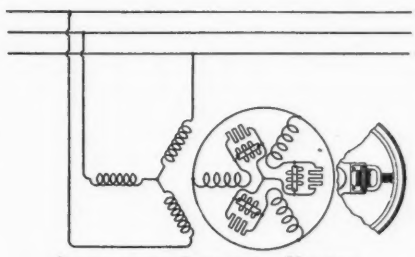


ELECTRICAL MEASURING INSTRUMENT.

the moving coil is very closely proportional to the amount of current flowing in the coil. In early and primitive forms of this instrument it was customary to suspend the moving coil by means of conducting filaments, which provided a conducting path to lead the current into and out of the moving coil, and in addition constituted a restraining force which tended to bring the coil back to its original or zero position when the current flow ceased. In somewhat later times the original construction was modified to the extent that the moving coil was suspended by means of pivots carried in jeweled bearings and the current was conducted into and out of the moving coil by means of flexible filaments which might of themselves constitute a restraining or controlling force or which might be used in connection with springs, which springs would constitute a restraining or controlling force. The extent of movement of the moving coil when such an instrument was properly calibrated by reference to a standard of voltage or current constituted a measure of the current flowing through the coil and in consequence enabled the user to read directly the actual electromotive force or current flow in the circuit under measurement. In order that the field of force generated by the permanent magnet should be uniform within the space traversed by the moving coil, thus giving a movement of the coil directly proportional to the increase or decrease of current flow in the moving coil, it has been customary to curve the pole-pieces to the arc of a circle and to provide a core circular in section, which core was located within the moving coil, but separated from it by an air-space, so that the moving coil moved or oscillated within the annular space within the pole-pieces and core, the core itself being constructed of some substance, such as iron, which is a good magnetic conductor. In all instruments on this principle which have been heretofore constructed the curved pole-pieces, together with the core and the moving coil, together with the pointer, have been secured together, constituting an integral part of the instrument. It was, therefore, necessary in the construction of such instruments to assemble the parts referred to above and then attach to them the permanent magnet by means of screws or pins. This form of construction made it necessary to remove the permanent magnet from the pole-pieces several times during the course of construction and calibration and also whenever it was necessary to take the instrument apart for purposes of repair or recalibration. This was a serious disadvantage, since it involved breaking two magnetic joints and resulted in a change of strength in the field generated by the permanent magnet. With our present knowledge and facilities it is a simple matter to construct the moving coil, together with its conducting filaments, controlling springs, pivot points, and jewels so that they will remain constant and unchanged throughout a practically indefinite period of time. We have not, however, learned as yet to construct a permanent magnet which under all conditions will retain its initial magnetism, and the principal source of error in instruments of this class consists in the gradual loss of magnetism in the permanent magnet field, which results in error in the indications of the instrument. Since the maintained accuracy of this type of instrument is dependent on maintaining the constancy of the permanent magnet field, it follows that any construction tending to preserve the initial constancy of the permanent magnet is of

considerable advantage. Mr. Stevens has found that one of the principal causes of decreased field strength is due to the breaking of the magnetic joint existing between the pole-faces of the permanent magnet and the pole-pieces attached thereto. To overcome this defect in construction, he has devised a combination of supporting bracket, core and moving coil so constructed and related to one another that they may be removed from the field of force without disturbing the pole-pieces of the permanent magnet.

The General Electric Company has purchased from Arnaldo P. Zani, an Italian, residing at Berlin, Germany, a patent obtained by him in this country on improvements in controlling induction motors. Mr. Zani describes his invention as follows: In starting induction motors a non-inductive resistance is commonly inserted in circuit with the windings on the induced member of the motor in order to increase the starting torque and at the same time reduce the amount of current supplied to the motor. The resistance has the effect of bringing the currents in the induced member of the motor more nearly into phase with the electromotive forces induced therein and at the same time by reducing the amount of secondary current causes a more than correspondingly large reduction in the primary current. This reduction in the primary current is largely due to the fact that a reduced secondary current reduces the leakage flux between the inducing and induced members of the motor, and consequently reduces the amount of lagging or idle current called for by the self-induction produced by this leakage flux. A further description of the function of the starting resistance is unnecessary, since its operation is well understood by engineers. In practice the non-inductive resistance may be operatively connected to the windings of the induced member in a number of ways. Thus, for example, if the rotor be the induced member the resistance may be carried by the spider of the rotor or may be otherwise mounted within the same, or, if desired, the resistance may be located externally to the motor and connected to the windings of the induced member through collecting-rings on the rotor shaft. If the resistance is mounted within the rotor, it may be cut in or out by means of centrifugally actuated switches carried by the rotor or by means of switches mounted on the rotor and connected by suitable mechanical devices with a switch handle fulcrumed to some portion of the stator in a manner well known in the art. In cases where the resistance is externally located the same may be varied in value by any well-known means. In any case, however, these constructions are seldom absolutely sparkless in operation and are open to all the other objectionable features inherent in sliding contacts. In most cases the sparking produced at the contacts is not of sufficient importance to become seriously objectionable, while in some cases, it is, on the contrary, so dangerous as to be prohibitive—as, for instance, where the motors or other devices are to be used in an atmosphere of an explosive nature, such as exists in flouring mills, oil refineries or the like. He has therefore devised a means for starting induction motors which possesses the advantages of the well-known rheostatic form of control, though acting on a different principle, without its corresponding disadvantages. According to this invention the currents in the induced member of the induction motor are caused to flow through a circuit so organized that at starting it has the effect of a circuit containing a high ohmic resistance and at full speed the effect of a circuit containing a low ohmic resistance. In the preferred embodiment of the invention, the circuit through which the currents in the



CONTROLLING INDUCTION MOTORS.

induced member of the motor are caused to flow is provided with alternative paths, one of high ohmic resistance and little, if any, self-induction and the other of low resistance with a comparatively high self-induction. At starting when the frequency of the currents in the induced member is high the reactance in the path of high inductance is so large as practically to prevent any considerable current from flowing in this path, thus causing nearly all of the currents generated in the induced member to pass through the high-resistance path. The result obtained is nearly the same as though the high-resistance path were the only one presented to the induced currents of the induced member, and the circuit as a whole has the effect of a circuit containing a high ohmic resistance. As the speed of the machine rises, however, the frequency of the currents in the induced member becomes less and less, thus correspondingly decreasing the reactance due to self-induction, and so causing a greater portion of the induced current to pass through the self-inductive path and less through the path of high resistance. When the motor approaches full speed, the frequency of the current in the induced member becomes so low that the counter-electromotive force of self-induction in the inductive path is greatly reduced. Then nearly all of the current will flow through this path, which is of low resistance, and only a small amount through the other path of high resistance, and the circuit as a whole will have the effect of a circuit containing a low ohmic resistance. This operation preserves the proper phase relation between current and electromotive force at all speeds without any mechanical adjustment whatsoever, though, if desired, the amount of reactance due to the inductive path above mentioned may be still further varied, not by depending alone upon a decrease in the frequency of currents flowing in said path, but by also varying the coefficient of self-induction to the inductive device in any desired manner—as, for instance, by varying the reluctance of its magnetic circuit.

Association of Edison Illuminating Companies.

The twenty-fourth convention (nineteenth annual meeting) of the Association of Edison Illuminating Companies will be held at the Frontenac, Thousand Islands, St. Lawrence River, N. Y., commencing Tuesday, September 8, 1903, at 9.30 A. M. A most successful convention from every point of view is expected and the committee wishes to impress upon each member that he should not fail to send at least one delegate to this important meeting. The following list of papers has been prepared:

"Commercial Experience with Nernst and Meridian Lamps," by W. B. Thompson, Detroit, Mich.

"Purchased Electric Power in Factories," by E. W. Lloyd, Chicago, Ill.

"Operating Features of High-Tension Power Stations," by W. F. Wells, New York, N. Y.

"Position of Steam Turbines in Central Station Operation," by August Kreusi, Schenectady, N. Y.

"Overhead Pole Line Construction and Operation," by A. H. Manwaring and J. T. Hutchings, Philadelphia, Pa.

"Comparison of European and American Engineering Practice," by Charles Schwartz, Chicago, Ill.

"Profitable Advertising," by W. H. Johnson, Philadelphia, Pa.

"The Central Station and the Isolated Plant," by Douglass Burnett, New York, N. Y.

"Depreciation in Electric Light Plants—How Estimated and Applied," by H. M. Edwards, New York, N. Y.

"Selection and Installation of High-Tension Switching Apparatus," by Leonard L. Elden, Boston, Mass.

"Illumination," by Charles P. Steinmetz, Schenectady, N. Y.

"Results Obtained with Steam Turbines in Milan, Italy," by Guido Semenza, Milan, Italy.

"The Development of Summer Lighting," by E. A. Leslie, Brooklyn, N. Y.

"Notes on Commercial Features of European Lighting Practice," by Arthur Williams, New York, N. Y.

Reviews of Current Engineering and Scientific Literature.

Tests of Water-Tube Boilers on Ship Ports.

The British Admiralty has been conducting some elaborate tests as to the suitability of water-tube boilers of the Belleville type for vessels of the navy. Two similar vessels, one equipped with water-tube boilers and the other with the Scotch type, were fitted with propellers which gave them equal speeds. The two were then started from Plymouth to Gibraltar in company for a test of the relative coal and water consumption. The water-tube boilers lost less water and burned less coal than did the other. A trial was then made to determine the least time in which the two vessels could be coaled and got ready for sea. That equipped with the water-tube boilers got ready in twenty-one hours, while the other required forty-five. At a signal being given to light fires and start, the water-tube boilers got up steam in twenty-six minutes, but the other required sixty-four. Recent tests have also been made with these boilers on several vessels of the French Navy which showed results confirming those obtained by the English vessels. The French cruiser Devestation, rated at 8,300 horse-power, burned 1.85 pounds of coal per horse-power-hour when indicating 8,856 horse-power. The French cruiser Dupleix, rated at 17,100 horse-power, consumed 1.75 pounds of coal per horse-power-hour in developing 17,980 horse-power. The cruiser Marseillaise, 20,300 horse-power, consumed 1.53 pounds of coal per horse-power-hour when indicating 14,493 horse-power. These figures show the efficiency of the water-tube boiler.—*Abstracted from the Steamship (Leith), August.*

Measuring the Variation of Current in a Coil During Commutation.

If a coil of fine wire having the same number of turns and being wound side by side with an armature coil is assumed to cut the same total flux as the latter coil, then the electromotive force set up in it will be equal to that in the armature coil. Therefore, if one end of this coil is connected to one end of the armature coil but in such a way that their electromotive forces will be opposed, the difference of potential at any instant between the two free terminals will be equal to the fall of potential in the armature coil, due simply to ohmic resistance. This method has been applied by M. Iliobici to study the variations of current in the coils of a direct-current machine during commutation. The results so far obtained agree with those obtained by other methods and this seems to indicate that the method is reliable. Great care should be exercised in winding the fine wire so as to get it in the best possible position and thus minimize any error which might arise from leakage or an unequal rate of cutting flux. This detail of the method is now being studied by the author with a view to determining the best position for the exploring coil of wire. In order to do this the author purposes to study simultaneously the variation of current by the method just described and by the following: Into each coil of the armature a non-inductive resistance will be introduced. Then by measuring the fall of potential through this resistance at any instant, the intensity of the current at that moment may be determined. The results obtained in this way will be compared with those obtained by the other method, and by winding the exploring coil in various positions the best one will be determined.—*Translated and abstracted from L'Electricien (Paris), August 1.*

The Storage Battery in Its Relation to the United States Fortifications

The value of the storage battery as a reserve for coast defence work, is here discussed by Lieutenant Lee Hagood. For this purpose accumulators are used for the searchlight, for the entire electrical supply, including field lighting and power and in connection with harbor mines. It is indispensable in the use of the telautograph and for signaling systems and as a substation. For the latter purpose batteries may be charged in series at a high voltage and discharged in parallel, and in this way effecting a considerable saving in copper. The function of the storage battery is, primarily, for this service that of a reservoir for electric supply. Several years ago it was decided to install small electric plants in the various fortifications. In the beginning the object was merely to obtain satisfactory light, but so many applications of electricity have since arisen that at present the electric supply has grown to be one of the most important considerations in the equipment of a modern fort. Its use may be divided into two heads; in the fortifications and lighting the post. About the fortification itself the electric supply is for the following purposes: Ignition of fuses, lights for electric night sights, lights for range finder cross-hairs, for telephones, for time interval bell circuits, for master clock circuits, for lighting the battery, for lighting range finder stations, for operation of the night signals, telautographs and searchlights; the motors for control of the guns, ammunition hoists, shot room and ventilating fans. For the above purposes service must be uninterrupted and reliable, and for this work the storage battery is well adapted. The author discusses various types of the storage battery and the systems of applying these and the various booster systems. —*Abstracted from the Journal of the United States Artillery, Fort Munroe, July and August.*

Chelsea Generating Station.

This article gives an outlined description of the Chelsea generating station which is now being constructed by the Underground Electric Railways Company, of London. The site comprises about three and one-half acres of land with a water frontage on the Thames and Chelsea Creek. The building is 454 by 175 feet and 104 feet high to the peak of the roof. The capacity of the building at normal load is 57,000 kilowatts. On this basis the cubic feet per kilowatt, including office building, is 139, and the square feet per kilowatt is 1.36. The building is of steel frame closed with brick and terra-cotta, unornamented. The roof and most of the floors will be concrete. The boiler room will contain eighty water-tube boilers arranged two stories high and equipped with mechanical stokers. The main generating sets each consists of a horizontal turbine engine running at 1,000 revolutions per minute and a three-phase generator wound for 11,000 volts, thirty-three and one-half cycles. There will be ten such sets with floor space for one of half the size. The normal rating of each generator is 5,500 kilowatts, but they will carry an overload of fifty per cent for two hours at practically the same steam consumption per kilowatt-hour. There will be four 155-kilowatt, 125-volt steam-driven exciter sets. The condensing system consists of vertical condensers located in pits between the engine foundations.

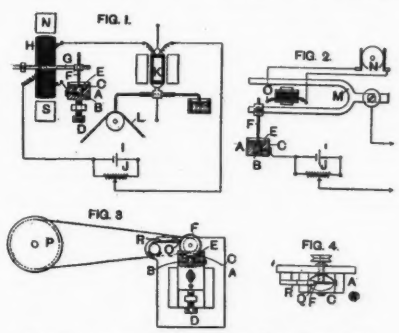
The switchboard is carried on three gallery floors extending across the north side of the engine room. High-tension switches will be motor-operated and the feeder system extending to the twenty-three substations will be in duplicate. A line of sixty-four ducts is being constructed to carry these feeders to the nearest point of the district railway. Coal will be received on lighters and discharged into bunkers which have a capacity of 15,000 tons. The daily consumption will reach 800 tons.—*Abstracted from the Electrical Engineer (London), July* 31.

The Telegraphone.

Some recent improvements in the design of Poulsen's telegraphone are described in this article, the latest types of which are now on exhibition in London, though they have not as yet been placed upon the market. The principle of the instrument remains the same. The current from the secondary of an ordinary microphone and induction coil system passes through a coil surrounding a small magnet under which a continuous steel surface is drawn. The steel is magnetized in a manner corresponding to the variations of current produced by the voice and when the coil is connected to an ordinary telephone receiver and the magnetized steel surface again drawn under the magnet the original words are reproduced. In the original form the record was taken on a steel wire wound spirally upon a drum. One of the present type replaces this wire by a steel disc, making a very compact arrangement. This disc is about five inches in diameter and is held on a rotating plane by a milled nut. As the disc rotates the recording magnet is moved toward the centre of the disc by a micrometer screw driven back by the clockwork which also drives the disc. The speed of rotation is such that a constant velocity of one-half metre per second is maintained under the magnet, the disc speeding up as the magnet approaches the centre. For erasing the record a bar magnet with a flattened end is used. The recording magnet is a pointed needle surrounded with a coil imbedded in insulating composition and held in a small ebonite cylinder. For the larger instrument a steel wire is used which is wound from one wheel to another. This wire passes between the poles of three pairs of magnets. The centre pair is that used in recording and reproducing the message. The other two are used for erasing the message, two pairs being used so that an old record may be erased with the wire passing in either direction. The articulation of these new types is good and there is freedom from foreign noises such as are heard in other types of talking machines. On the other hand the loudness of speech is less with this apparatus than with the others.—*Abstracted from Electrician (London), July* 31.

Coherers for Wireless Telegraphy.

A British patent granted to Sir Oliver Lodge, of Edgbaston, Birmingham, A. Muirhead and E. E. Robinson, and described in the *Mechanical Engineer,* London, relates to improvements in coherers such as are employed as detectors or receivers in systems of wireless telegraphy. In their design the inventors use a more definite kind of film, and obtain the necessary light pressure in a more definite manner than hitherto. Three designs of coherer are illustrated herewith. Fig. 1 shows the coherer attached to a recorder



COHERER FOR WIRELESS TELEGRAPHY.

coil in the "coherer" circuit; Fig. 2 represents it attached to a tuning fork, and Figs. 3 and 4 illustrate the wheel-form of it.

Referring to Fig. 1, F is a platinum needle attached to an arm G carried by a recorder coil H, *i. e.,* a rectangular coil of insulated copper wire pivoted or suspended between the poles of a magnet NS. Beneath the needle is placed a trough C containing mercury B. A layer of paraffin oil is poured upon the mercury B and the trough adjusted by means of the screw D until the needle point F just enters the mercury B. A suitable portion of the voltage of the single cell I is applied to the coherer A by shunting the cell with a resistance J and making connections at one pole of the cell and at an intermediate point on the shunt. The cell I is joined up between the mercury pole B of the coherer and one terminal of the coil K of a siphon recorder. The recorder K is in series with the recorder coil H and the needle F of the coherer connected to one terminal of the cell or battery I. So long as the amount of voltage applied to the coherer is about three-tenths of a volt or less, the thin film of oil between the needle point F and the mercury B will prevent the passage of an appreciable current through the coils H K, but on the arrival of ethereal waves from a distance the voltage between the needle point and the mercury is instantaneously and temporarily increased sufficiently to break down the oil film and allow a current to flow across it from the battery I, the result being a deflection of the recorder coil K, producing a signal on the tape L, and a deflection of the coil H in the direction to raise the needle F out of the mercury B. This withdrawal of the needle point F from the mercury B and reimmersion in the same on the cessation of the current through the coil H restores the continuity of the thin film between the needle point and the mercury and prepares the coherer for a succeeding electric wave or signal.

In Fig. 2 the needle point F is shown attached to one of the prongs of a tuning fork M, which is kept vibrating by means of an alternating or intermittent current (generated by an alternator N) flowing through a bobbin of wire O placed between the prongs of the fork. The vibration of the needle point F in the mercury B thus produced restores the continuity of the film of oil immediately after the breaking down of the latter by ethereal waves from a distance, or a spark in the neighborhood.

In Figs. 3 and 4 the conducting part F is shown in the form of a disc slightly immersed in the mercury B. The constant rotation of the wheels, effected by a clockwork train P, brings about the restoration of the continuity of the oil film between the wheel and the mercury after the cohering action of ethereal waves received from a distance, as in the two former cases. The amount of pressure of the mercury upon the disc or wheel is regulated by means of the screw D. To clean or wipe the edge of the conductor F before it enters the mercury B, and thus obviate the prejudicial effects of stray disturbances upon the recorder slip, a pad of felt Q is employed mounted in light contact with the conductor F, for which purpose it is secured to a spring R.

Mr. E. Hauser has found that the rate of interruption of the Wehnelt interrupter may be greatly increased and its starting potential lowered by employing dilute sulphuric acid and adding to it twenty per cent of its weight of sulphate of magnesia.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

An Automatic Igniter.

The accompanying illustration shows the Apple automatic igniter which is manufactured by the Dayton Electrical Manufacturing Company, of Dayton, Ohio. The weight of this automatic igniter is sixteen and one-half pounds and its extreme dimensions are five by six by eleven inches. The igniter does away with bat-

AUTOMATIC IGNITER.

teries, belts and switches; is simple and compact, and while it is entirely enclosed provision is made for easy accessibility to its working parts. The design, as may be seen from the illustration, makes it dust, dirt and water-proof. The apparatus consists of an Apple dynamo fitted with an Apple friction governor that will maintain the speed of the dynamo at 1,400 revolutions per minute, irrespective of the speed of the engine.

There is now a demand, created by the adoption of gasoline motors to all kinds of power work, for an igniting dynamo which will furnish current for ignition at all times; as modern gasoline motors are subject to considerable changes of speed there is more or less difficulty in getting perfect service from the ignition apparatus. The application of the Apple governor to the igniter, the company claims, obviates any difficulties in this direction and controls absolutely the speed of the dynamo.

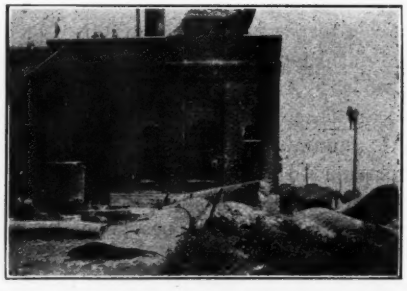
The company guarantees the following features in the operation of the automatic igniter: It will spark an engine at very low speed by reason of the permanent magnetic pole-pieces which are kept strong by the field coils when up to normal speed, and with the friction governor the machine can use extremely small friction without slippage when starting; it will furnish a very great output at reasonable speeds and it can be attached to any gas or gasoline motor by any one without the necessity of having previous experience.

Testing a New Air Brake in Germany.

A consular report states that a recent meeting of a commission composed of representatives of the Imperial Prussian, Bavarian, Saxon and Baden state railroads was held early in July in order to test the new Steiner distance brake, which is said to be an improvement upon those now in use. It is so connected to the air brakes of a train that when the front wheels of a locomotive pass over a danger signal placed upon the tracks it will automatically put on the brakes, at the same time opening the whistle valve. The report says that the apparatus worked with perfect satisfaction at the speed of 83.75 miles per hour, but because of the extraordinary strain to which it was subjected an important part of the brake was broken. The commission has recommended that an extended trial be given the Steiner brakes upon the regular train service.

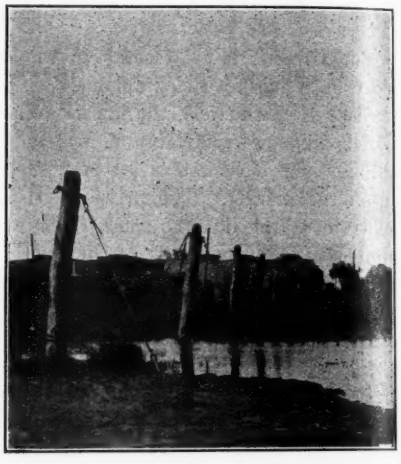
A Severe Test for Guy Anchors.

The accompanying illustrations give a pretty good idea of the great damage which was brought about during the recent storm at East St. Louis. The photographs from which these illustrations were made were taken the day after the storm which wrecked the stacks of the large power-house of the East St. Louis & Suburban Railway Company. These stacks were 6 feet in diameter and 160 feet high. They were guyed with three-quarter-inch steel cables to twenty-four twelve-inch Stombaugh guy anchors bored in their full lengths. In every instance the three-quarter-inch cable was



WRECKED STACKS AT ST. LOUIS. THE GUY ANCHORS UNMOVED.

snapped like so much thread, but the guy anchor did not move an inch. This power-house is one of the largest west of Chicago. The East St. Louis & Suburban Railway Company is using the Stombaugh guy anchor for all its belt-line guying also. The Stombaugh guy anchor was described recently in these columns. It consists essentially of a saddle-shaped plate which was placed vertically in a hole bored four or five feet in the ground in a slanting direction. After the plate has been deposited at the bottom of the hole the earth is tamped in all around it and more solid pressure is then taken upon the guy line which is joined to the plate, and the mechanical moment is of such a nature that the plate is swung



THE GUY STUBS AND ANCHORS STANDING UNMOVED AFTER THE STORM.

around so that it assumes a position at right angles to the direction of the pull.

Messrs. W. N. Matthews & Brothers are the exclusive distributors for these anchors, with headquarters at 600 Carleton Building, St. Louis, Mo.

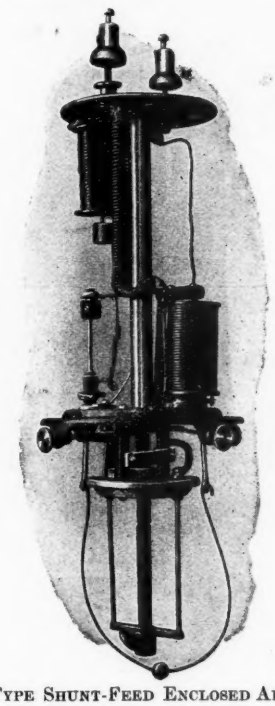
Money Orders by Wireless Telegraphy.

The Cunard steamship Campania has the honor of establishing the first wireless telegraphy money order office in the middle of the Atlantic Ocean. One of the saloon passengers on the Campania, soon after leaving Queenstown, discovered that he had insufficient ready money to pay numerous expenses, and, not having any friends on board, was under considerable embarrassment as to means for providing himself with cash. He remembered that his mother was a passenger on the Lucania, which left New York the same day that the Campania sailed from Liverpool, so arrangements were made to pick up the Lucania by wireless telegraph and make a request of the gentleman's mother to pay the purser of the Lucania £10, asking him to advise the purser of the Campania to pay the money to her son. Communication was established at fifty miles

distance, both ships being then in mid-Atlantic. The messages were sent and received with great facility and easily understood. After the message to the lady on board the Lucania was properly understood, the purser of the Lucania telegraphed a message to the purser of the Campania to pay the young man the money, as he had collected it from the mother on board the Lucania.

A New Type of Shunt-Feed Enclosed Arc Lamp.

The accompanying illustration shows a new type of shunt-feed enclosed arc lamp



NEW TYPE SHUNT-FEED ENCLOSED ARC LAMP.

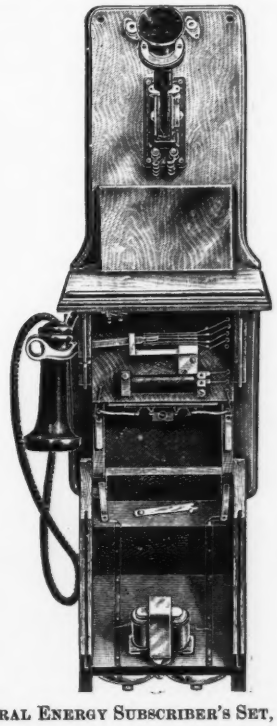
which has been designed by W. F. Warner, of Muncie, Ind. Mr. Warner has been a practical electrical lighting engineer for over twelve years and at present is superintendent of the city lighting plant at Muncie. His experience has given him facilities for understanding the exact requirements of a lamp of this nature. Notwithstanding many advantages which the enclosed arc lamp is claimed to give over the old open type, many operators hesitate in the adoption of the new system because of the expense of making the change, and there has been a demand for some time for a successful enclosed arc lamp which could be operated in connection with the present machine equipment. Mr. Warner began experimenting in this line a number of years ago and worked out the shunt-feed enclosed arc lamp which has been under a constant burning test up to the present time. Its operation has proven so economical and satisfactory that he has decided to place this on the market on a permanent business basis. The illustration shows the working parts of the lamp, the hood and globe being removed. Its operation is positive and simple, and the manufacturer states that the lamp has been adopted for street lighting in several cities.

The Curtis Turbine in Chicago Electric Light Station.

The first 5,000-kilowatt Curtis turbine-generator was run experimentally last week at the Fisk street station of the Commonwealth Electric Company, of Chicago. It carried its rated load about three hours. No economy tests were made, yet there was every indication that the machine when tested in this respect will equal, if not excel, the best compound condensing engine. Further experimental trials are being made. The capacity of the machine is reported to be at least fifty per cent above its rated load. This is believed to be the largest load carried on any turbine-generator.

A New Central Energy Subscriber's Set.

The accompanying illustrations show a new type of central energy subscriber's apparatus designed and placed on the market by the Fahnestock Transmitter Company, 74 Cortlandt street, New York

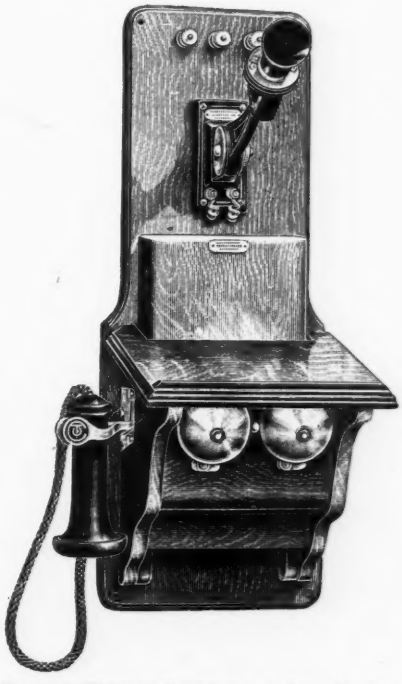


CENTRAL ENERGY SUBSCRIBER'S SET, OPEN.

city. This set embodies considerable novelty in the design of the woodwork, inasmuch as the condenser receptacle occupies the usually vacant space between the writing shelf and the transmitter. This permits of a material shortening of the set and improves its appearance generally.

The lower half of the box covering the hook switch, ringer magnet and coil is arranged to hinge downward and in doing so uncovers the lower end of the condenser receptacle. This permits of the removal of the condenser without disturbing any other part of the set.

When closed the box is fastened by a lock and key which prevents any possibility of its being tampered with. The



CENTRAL ENERGY SUBSCRIBER'S SET, CLOSED.

hook switch and coil are mounted on the condenser receptacle and when the box is open are easily inspected.

This set is equipped with the company's button type of transmitter and its new hook switch.

Proceedings of the Engineer Society of Western Pennsylvania.

The June issue of the Proceedings of the Engineer Society of Western Pennsylvania contains the following papers: "Advance in Modern Steel Construction," by L. F. W. Hildner; "Nickel Steel for Purposes of Construction," by Ralph H. Watson; "Steel Forgings," by T. D. Lynch; "Some Characteristics of Good Forgings and Some Things to Avoid," by James H. Baker; "Drop Forging," by Dwight Goddard; "Castings in Modern Construction," by D. McDougal; "Properties of Wire in Telephone Work," by R. A. L. Snyder, giving briefly the properties of various kinds of wire and the sizes generally used; "Cold Rolled Steel," by J. J. Crane; "Power Plant Design," by R. W. Stovel; this considers briefly the location and arrangement of the proper setting of the various apparatus and the efficiencies obtainable and gives some details of the equipment of the modern construction of moderate size.

The Utilization of Electric Motors by a Terminal Company.

The Bush Terminal Company is one of the latest developments of the transportation problems in and around New York Harbor, and its development and profitable operation is the result of the congested terminals on Manhattan Island and in New Jersey.

The corporation has acquired a large acreage and an extensive water front extending from Thirty-ninth to Fifty-second street, South Brooklyn.

It has completed four docks, each one of which is larger than any other dock in New York Harbor, and has built warehouses and laid down nearly thirty miles of railroad. It handles freight in freight cars directly from the railroads and on to the docks, thereby saving not only the increased dock charges of New York city but the cost of rehandling. It connects its railroad lines with the various railroads terminating in and around New York city by means of barges on as regular a schedule as the schedule of any railroad. It is equipped with tugs, barges, lighters, railroad cars, steam locomotives and electric motors.

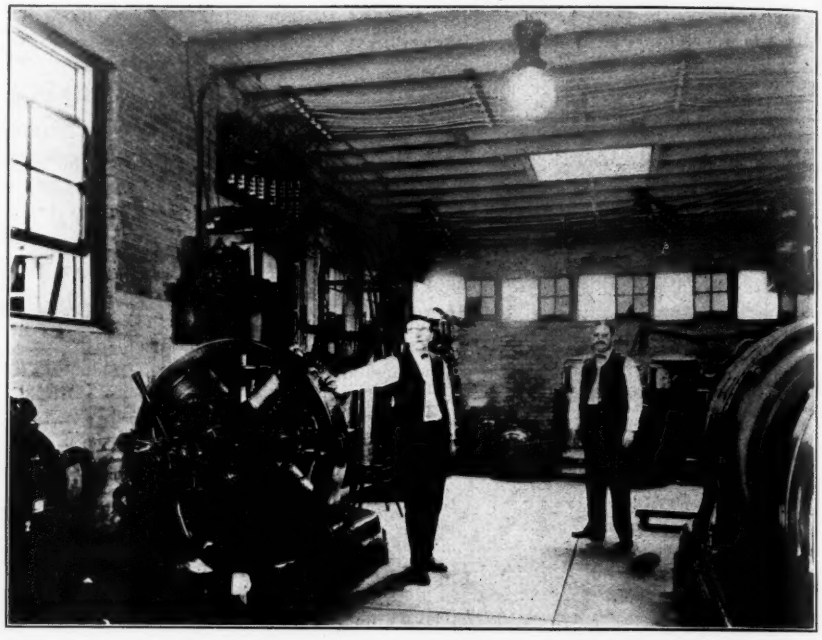


FIG. 1.—VIEW IN TRANSFORMERS SUBSTATION, BUSH TERMINAL COMPANY.

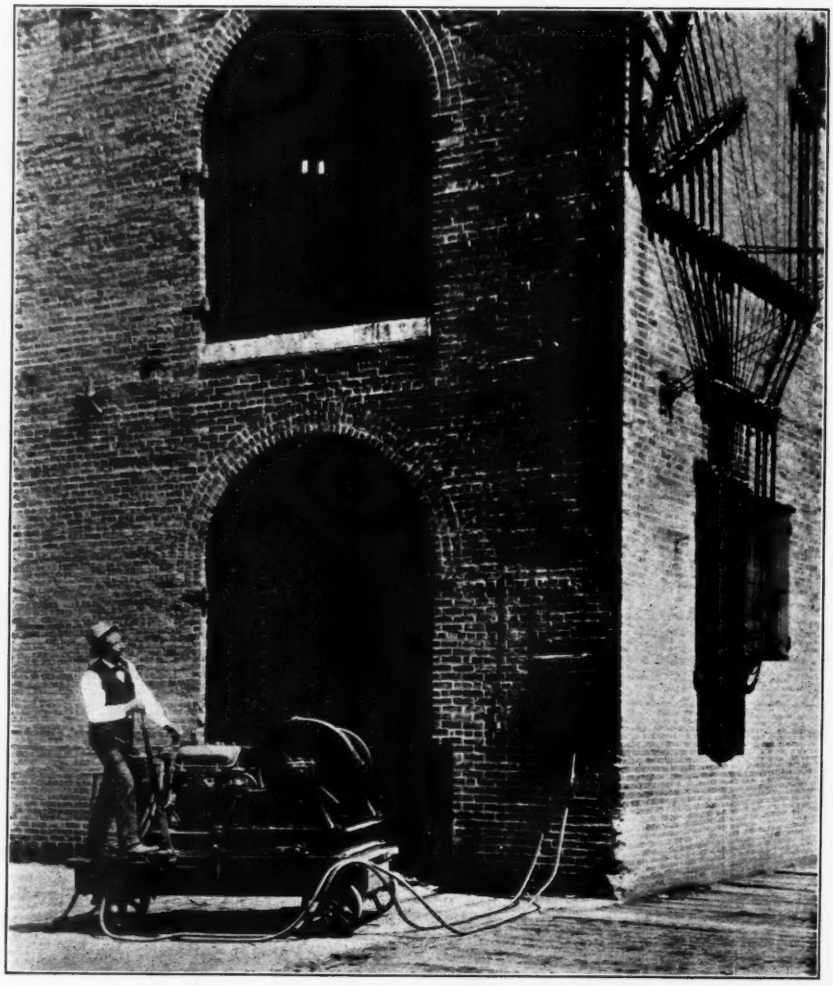


FIG. 2.—PORTABLE MOTOR AND TERMINAL BOXES, BUSH TERMINAL COMPANY.

The property is under the direction of Mr. Bush, the president, and Mr. Goodrich, general engineer, both of whom are technically educated engineers, and, as may be expected from this situation, modern facilities and economic methods of handling have been introduced.

The utilization of the electric current for the rapid and economic handling of freight and packages has been developed to its fullest extent. At the present time the company obtains its power from the high-tension main of the Brooklyn Edison Company. Alternating current at 8,000 volts is converted into 300 volts direct current and distributed around the plant. (The substation is shown in Fig. 1.) The wiring is on the four-wire system and located at convenient intervals both inside and outside of the piers and warehouses, as is shown in Fig. 2. Portable electric motors and hoists are used almost exclusively for handling the packages. The specifications call for an electric motor, which at eighty amperes and 220 volts will raise one ton 250 feet per minute, and the service test of the motors is dropping one ton 100 feet and catching it before it reaches the ground in the last ten feet of fall. It is extremely interesting to watch the various uses made of these portable electric motors. Two will be brought together and operated by one man, the two ropes going through different pulleys in such a manner that packages can be hoisted, swung and deposited without the necessity of rehandling. This hoisting will be done by one motor, then a second motor will tighten on its rope and release the first motor which will cause the package to be deposited on the pile, or on or in the

freight car. Two electric motors and two stevedores will handle across the dock, and into or out of the warehouses more tons or more packages than a crew of from twenty to thirty men, varying according to the articles being moved. The saving in time and labor by using the electric motors, in some instances, is something over seventy-five per cent. Fig. 3 represents two motors used in taking cotton out of the freight cars and handling it up five stories and into the warehouses.

Municipal Steam Turbine Plant, Anderson, Ind.

An interesting municipal electric lighting plant enterprise is under way at Anderson, Ind., and marks the second introduction of the steam turbine in American municipal power plant service. The city of Anderson has for some years operated an electric light plant in connection with the city waterworks, located near White River. The electric installation is housed in a separate building, approximately 50 by 100 feet, adjacent to the waterworks plant whose boilers furnish the steam power necessary for the operation of the electric light plant.

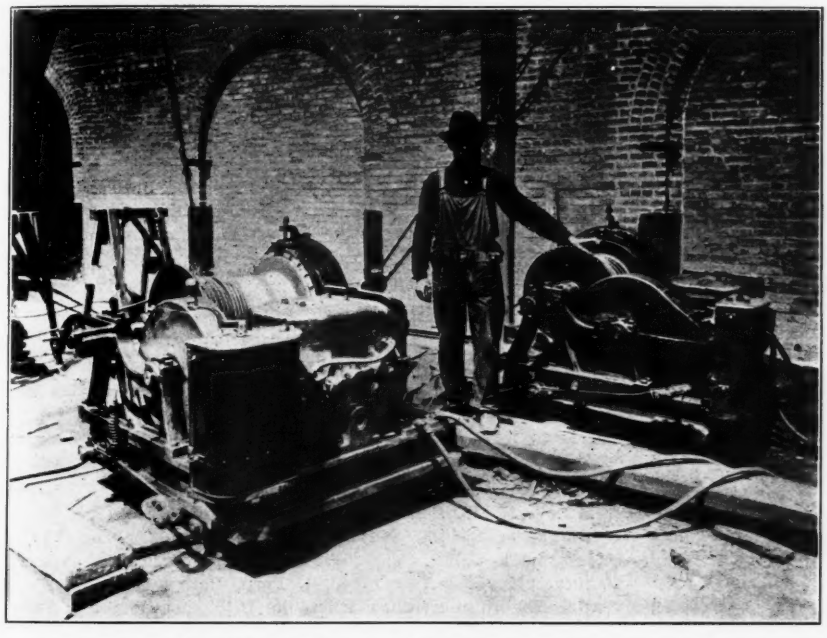


FIG. 3.—TWO MOTORS HANDLING COTTON BALES FROM FREIGHT CARS.

The present lighting equipment comprises two belted generating units, but the increasing demand for light and power renders the available capacity inadequate to carry even the present load, at times resulting in a severe overloading of the entire equipment. In order to secure immediate relief from these conditions and avoid the necessity of erecting additions to the power-house, Westinghouse steam turbine generating units have been selected for power extensions. At the present time two 400-kilowatt units will be installed, together with one twenty-kilowatt exciter, direct-connected to a Westinghouse standard engine, and a complete switchboard equipment.

As the result of the employment of turbines in this plant it has been found possible to install a complete boiler plant in the electric light building, thus rendering the operation of the lighting system entirely independent of the waterworks system. The new boiler plant consists of three 310-horse-power Stirling water-tube boilers equipped with Roney mechanical stokers. The boilers will not be arranged for superheat, but will supply saturated steam to the turbines at 150 pounds pressure, all condensation being returned to the boilers by a steam loop and Holly gravity return system. The turbo-generators will furnish three-phase current to the lighting power and distributing system at a frequency of 7,200 alternations and at 2,200 volts pressure, no step-down transformers being used. The turbine equipment will operate condensing as the plant is located near the river bank where condensing water is available. Surface condensers will be used and the condensation from the turbines will be returned directly to the boilers, as the exhaust is entirely free from oil.

An interesting feature of the turbine installation is brought out by the fact that by replacing the belted units with turbine-driven units, sufficient space is made available for the installation of the complete boiler plant, together with an additional turbine unit and the necessary boilers at such times as the future demands upon the plant require this extension.

E. R. Vincent, M. E., of Indianapolis, Ind., has been retained by the city of Anderson as consulting engineer, and the installation is under his general supervision.

Sprague Flexible Metallic Conduit for the Interborough Subway Cars.

A recent testimony to the value of flexible metallic conduit was made by Vice-President and General Manager Bryan, of the Interborough Rapid Transit Company, New York city, in an interview published in the New York *Sun*, August 12. Speaking of the fireproof construction of the new cars for the subway, and the impossibility of the Paris accident being repeated in New York, he says: "The wiring for lighting the cars is on the roof away from the passengers. Two small wires are insulated with asbestos and carried in conduits of flexible metal." The flexible metallic conduit which he refers to is that manufactured by the Sprague Electric Company, which received the order for this type of conduit for the Interborough car wiring for lights. This type of conduit is excellent for car wiring as well as the wiring of buildings where thorough protection to wires and insulation is essential. Its flexibility is such that it can be bent around corners and over obstructions with ease, the energy required to bend it being no more than is required to bend a manilla rope of the same diameter. No elbows, therefore, are required and the installation is reduced to absolute simplicity.

The International Association of Municipal Electricians.

The eighth annual meeting of the International Association of Municipal Electricians will be held at Atlantic City, N. J., September 2, 3 and 4. The papers for discussion have been announced, and in some cases these have been distributed for perusal by the members, in order that an intelligent discussion might be brought about. The following papers have been distributed: "Records and Reports," by Austin S. Hatch, Detroit, Mich.; "The Importance of the Fire Alarm and Police Telegraph," by W. H. Thompson, Richmond, Va. There has also been established a question box, and a number of questions have already been filed.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MEXICAN ELECTRIC TRACTION—An electric traction system is to be built between Allende and Zarazoza, both places being located in the state of Coahulia, Mexico. The distance is about twenty miles. It is intended to eventually extend the line to Ciudad Porfirio Diaz, on the Mexican frontier. The line would then be about sixty miles long.

A HEAVILY CAPITALIZED HOLDING COMPANY SAID TO BE ORGANIZED IN CALIFORNIA—A holding company with a capital of $50,000,000 for the Huntington electric lines in southern California has been organized. Senator W. A. Clark, of Montana, and E. H. Harriman have a minority of the stock in the company, Hellman and Huntington keeping the control. The interested persons have decided not to disturb the existing four companies which represent the Hellman and Huntington lines.

NEW POWER-HOUSE—Within the next two weeks the Louisville Railway Company will begin the erection of a power-house at Meadow Brook station on the Third avenue Jacob Park car line. It will be a brick structure, two stories in height, and will cost about $26,000. The house will connect with the new power station at Logan and Lampton streets, and the voltage, coming from the latter station, will be reduced at the Third street station to the voltage necessary for operating the two Jacob Park street car lines.

BROOKLYN RAPID TRANSIT NOT TO EXPERIMENT WITH POULSON PLAN—The plans for relieving the congestion during rush hours at the loops at the Manhattan end of the New York & Brooklyn Bridge during rush hours will not be along the lines suggested by Mr. Niels Poulson. His plan was to construct a moving walk-way. President Edward W. Winter, of the Brooklyn Rapid Transit Company, has announced that the Poulson plan would practically receive no recognition at the hands of the Brooklyn Rapid Transit Company, inasmuch as the company is now carrying out the plan for four additional loops. The latter plan is now in course of construction and the passengers are using the local bridge cars at night while the work is going on.

THE CONNECTICUT POWER SCHEME—The New Boston & Springfield Electrical Power Company, with a capital of $4,000,000, has just been organized by New York promoters and capitalists and has secured the principal water privileges along the branch of the Farmington River from Otis, Mass., to New Hartford, a distance of about twenty miles, taking over the Greenwoods property in New Hartford and the rights recently secured in Otis and New Boston by the Boston and New York parties, Messrs. Flint, Gile and others. The purpose is to convert the water power along the river into electrical power and transmit it to Springfield, Mass., where it is said contracts have already been made to furnish 10,000 horse-power. It is estimated that 7,500 horse-power can be obtained at New Boston and upward of 6,000 horse-power at New Hartford and Otis. At least $3,000,000 will be expended along the Farmington River to develop this power.

INTERURBAN CORPORATION—A corporation, representing millions of dollars, has been organized at Beaumont, Tex., to build, operate and manage a great system of interurban lines. For some time there have been meetings between several capitalists from Ohio and many of the most prominent and influential of the capitalists of Beaumont. Their plans and objects have not been given publicity, but it develops that the secret sessions have had to do with a system of electric lines that will connect the oil and rice industries that have been flourishing in this section of the state, and handle their products to the gulf. The men interested in the project are: Messrs. E. R. Norvell, Captain William Wiess, Turner & Nabers, McFadden, Wiess & Kyle, T. S. Reed, W. C. Averill, G. W. Carroll, Captain George W. O'Brien, Colonel George A. Mill and John N. Gilbert, of Beaumont, and George M. Craig, of Port Arthur, John R. Lynn, of Springfield, Ohio, William Abbott Smith, Hugh Smith and Theodore Weyant, of Columbus, Ohio. The company is capitalized at $300,000, and application for the charter has been made. The corporation will be styled the Beaumont, Sour Lake & Port Arthur Traction Company. It has taken over the rights and holdings of the construction company now building between this city and Sour Lake, and, following the policy of that company, will lose no time, but complete the line in the same manner that it has begun. The company does not take over the Beaumont, Port Neches and Port Arthur lines, but will build a line between these points entirely separate and distinct. R. C. Welles, who has been the superintendent of construction for the old company, will act in the same capacity. George White has been engaged as chief engineer of the corporation. J. N. Lynn will act as consulting engineer and have personal charge of the electrical affairs. It is stated that the stockholders represent not only the best element of the city, but have over $10,000,000 behind the project.

PERSONAL MENTION.

MR. J. J. WELCH has been transferred from the position of manager of the Paterson district of the New York & New Jersey Telephone Company to take charge of the Jersey City office of the company.

MR. THOMAS A. EDISON, it is said, has perfected a commercial phonograph and made it practical for taking court testimony and other dictation. The record used is nine inches long, and capable of taking several letters.

MR. J. F. BLAUVELT, of the New England Butt Company, of Providence, R. I., was a New York visitor this week. Mr. Blauvelt's company is probably the largest manufacturer of insulated wire braiding machinery in the world.

MR. A. E. RODGERS, general manager of the Perth & Kalgoorlie Electric Traction system, is drawing up plans for an electric traction system to be constructed in West Australia, to operate in and around Essendon, Flemington and Kensington.

MR. A. W. DOUGLAS has tendered his resignation as secretary of the Shawinigan Water and Power Company, of Montreal, and is to leave for the Pacific coast. Mr. Douglas will be succeeded by Mr. Howard Murray, who has been connected with the company for a number of years.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the Westinghouse Electric and Manufacturing Company, the Standard Underground Cable Company, and other prominent American manufacturing interests in Chili, Peru, Bolivia and Ecuador, is visiting the United States, where he will place contracts for the electrical equipments of two extensive Chilian nitrate plants.

MR. H. E. HUNTINGTON, of Austin, Tex., it is announced, has purchased all the independent telephone toll lines in Texas, aggregating 1,000 miles, and for which he has paid $400,000. It is stated that Mr. Huntington has now closed negotiations for the purchase of the independent telephone exchanges located in Austin, San Antonio, Houston, Corsicana, Waco, Beaumont, and nearly a score of other towns in Texas, Louisiana and Indian Territory.

DR. J. A. McGOWAN'S paper on "First Aids and Appliances," which was read at the Chicago convention of the National Electric Light Association, has been reprinted and is being distributed to members of the association. This is in line with the suggestion that was made at the convention at the time the paper was read. The information contained in this paper is regarded as most valuable, and should be in the possession of every electric station manager.

MR. CHARLES L. EDGAR, Boston, Mass., president of the National Electric Light Association, was a visitor to New York last week, in connection with association matters. President Edgar has appointed a number of committees and editors of different departments to report to the twenty-seventh convention of the National Electric Light Association, which will be held in Boston, Mass., next May. These appointments will be announced later. By taking up active work at so early a period in the year Mr. Edgar hopes to furnish a convention programme that shall exceed in interest, if possible, the very attractive ones of the past years.

ELECTRICAL SECURITIES.

There was a very evident disposition manifested by large financial interests to bring about a cessation of forced liquidation and to support a decided raise in prices. The temper of the stock market throughout the country showed a decided change, in that the bull movement might almost be termed enthusiastic in its nature. All along the line prices advanced sharply, and these advances were held firmly all through the week, the markets closing strong on the last day. This condition of affairs has been prophesied for some time, and the question that is raised now is one which looks for an answer which will convey the reasons for the disastrous period which has just been gone through. There has been, even in the periods of greatest decline during the past eight or nine months, no internal complication which would justify the aggravated decline which set in early in the year and which has continued so steadily. Notwithstanding the pessimistic viewpoint of some speculators, following the protracted period of depression, an examination of statistics shows that there is little basis for an argument that industry in general is in any way radically wrong. Railroad earnings are breaking all past records for corresponding times, and while the cereal crop in one direction was more or less of a disappointment, this is more than compensated by record-breaking conditions in the surplus-producing territory. This condition of affairs will create a prosperous community among the agricultural interests of the country. It is also noticed that the iron and steel trades are enjoying a solid business, with no indications of any serious reversal. Railroad operatives are looking forward to a remarkable business during the coming harvesting season, and although railroad car shops are surfeited with orders, it is probable that there will be more or less of a car famine shortly to handle the moving interior commerce.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 15.

New York:	*Closing.*
Brooklyn Rapid Transit	45⅝
Consolidated Gas	179⅜
General Electric	164
Kings County Electric	165
Manhattan Elevated	135½
Metropolitan Street Railway	115
New York & New Jersey Telephone	145
Westinghouse Manufacturing Company	165

The Westinghouse Electric and Manufacturing Company has made application to the New York Stock Exchange for permission to list $9,135,200 of assenting stock. The money raised from the sale of this stock will be used for making extensions to plants to meet the growing business of the company and for working capital. A portion of this stock was issued in 1901, and the amount includes the $4,500,000 issued in May. This makes the amount of assenting stock outstanding $18,516,551, leaving nearly $2,500,000 of this class of stock still in the treasury.

The Kings County Electric Light and Power Company has declared a regular quarterly dividend of 2 per cent, payable to stockholders of record August 21.

The list of electrical securities shows a considerable advance since the closing prices for last week. Brooklyn Rapid Transit gained 6⅝ points; Consolidated Gas, 11⅜ points; General Electric, 14 points; Kings County Electric, 10 points; Manhattan Elevated, 6½ points; Metropolitan Street Railway, 6⅛ points, and Westinghouse Manufacturing Company, 5 points.

Boston:	*Closing.*
American Telephone and Telegraph	134
Edison Electric Illuminating	239
Massachusetts Electric	81
New England Telephone	123
Western Telephone & Telegraph preferred	82

The feature of the market during the week was the strong buying of American Telephone and Telegraph shares. During this buying the price held firm and was bid up 2½ points to 134. Edison Electric Illuminating gained 14 points. Massachusetts Electric was dealt in considerably. New England Telephone gained 3 points, and Western Telephone and Telegraph preferred held steady at 82.

Philadelphia:	*Closing.*
Electric Company of America	8 1/16
Electric Storage Battery common	55
Electric Storage Battery preferred	54
Philadelphia Electric	5¼
Union Traction	43¾
United Gas Improvement	84⅜

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	140
Metropolitan Elevated preferred	65
National Carbon common	21
National Carbon preferred	88
Union Traction common	4¾
Union Traction preferred	18½

It has been announced that the operating expenses of the Union Traction Company have been considerably increased since the universal transfer system was imposed on it by the city of Chicago a year ago next October. Before this period the company used about 1,000,000 transfers monthly, whereas at present 2,000,000 or thereabouts are necessary to meet the large traffic over the company's lines. It is stated that the Metropolitan Elevated traffic has been cut into three or four thousand a day on account of this transfer system.

NEW INCORPORATIONS.

BEATRICE, NEB.—The Virginia Telephone Company. $4,000.

WILMINGTON, DEL.—American District Telegraph Company. $20,000.

COUNCIL BLUFFS, IOWA—Summit Rural Telephone Company. J. C. Geister and others, incorporators.

AUGUSTA, ME.—Swain Island Telephone and Telegraph Company. $5,000. President, W. B. Snidsay; A. C. Smith, treasurer.

CINCINNATI, OHIO—The Interstate Telephone Company. Incorporators: S. P. Kineon, O. L. Perin, E. Zimmerman, R. H. Ellis-ton and F. K. Ludlow.

TRENTON, N. J.—The Saginaw Bay City Railway and Lake Company. $3,000,000. Incorporators: Joseph F. Cotter, William Eidell and I. C. Clow.

WAPAKONETA, OHIO—United Farmers' Telephone Company. President, R. A. Kerr; vice-president, M. Lavison; secretary, J. N. Graham; treasurer, C. C. Creps.

ADRIAN, MICH.—The Citizens' Electric Light, Power and Heat Company. $100,000. The new concern takes in the old electric light and power company.

WINONA, IND.—The Winona Electric Light and Water Company. $100,000. Its purpose is to furnish light and power to Winona, Warsaw and surrounding territory.

JAMESTOWN, N. Y.—Ashville & Panoma Telephone and Telegraph Company. $15,000. Incorporators: C. W. Appleby, A. H. Appleby, E. E. Berry, A. J. Peterson and B. D. Phillips.

OMAHA, NEB.—Monona Telephone Company; $100,000; incorporators: J. B. Huff, S. B. Martin and others. Goldfield Telephone Company; $10,000; incorporators: Howard Crill and others.

WAPOKONETA, OHIO—The Buckland Telephone Company. H. D. Bowsher, T. B. Bowsher, Dr. R. W. Sharp, B. Graham, J. Edman, G. W. Romshe, S. A. Brookhart, C. Lathrop and C. F. Bowsher.

TRENTON, N. J.—Southern Kentucky Interurban Traction and Power Company. $125,000. Incorporators: C. W. Courts, J. M. McCutchen, J. C. Browder, S. R. Crewdson, R. P. Manley, R. R. Clark, J. W. Clark, H. S. McCutchen, W. P. Bainbridge.

JERSEY CITY, N. J.—Southern Telephone and Telegraph Company; $25,000; incorporators: Arthur Johns, E. P. Hervey, G. W. I. Dwinnell. Atlantic & Pacific Telephone and Telegraph Company; $2,500; same incorporators. Sauttum Telephone and Telegraph Company; $2,500; same incorporators.

TELEPHONE AND TELEGRAPH.

DALLAS, TEX.—A new automatic telephone system will be installed at Chelburne.

PHILADELPHIA, PA.—The Factoryville Telephone has been incorporated with a capital of $5,000.

BALLSTON SPA, N. Y.—A telephone line will be built to connect Galway and Ballston and points east.

NEWARK, OHIO—The Newark Independent Telephone Company is erecting an exchange at Granville.

DELPHI, IND.—The Cass County Security Company has bought out the Logansport Home Telephone Company.

MAYSVILLE, KY.—The Mutual Telephone Company has decided to build a new line from Dover to Fernleaf.

ENNIS, TEX.—The Independent Telephone Company is erecting a line to Corsicana, to connect with southern Texas.

DANVILLE, ILL.—An underground telephone service is being installed by the Vermillion County Telephone Company.

SYRACUSE, N. Y.—The Syracuse Telephone Company plans the expenditure of about $300,000 for the betterment of its service.

BOSTON, MASS.—At a meeting of the Whitman selectmen it was voted to grant a franchise to the Automatic Telephone Company.

PITTSBURG, PA.—The Federal Telephone Company is building a line from Washington, Pa., to Wheeling, about thirty-five miles.

SKOWHEGAN, ME.—The Hartland & St. Albans Telegraph and Telephone Company has been organized with a capital of $10,000.

JANESVILLE, WIS.—A new farmers' telephone line has been constructed to Willowdale by the Rock County Farmers' Telephone Company.

FLORENCE, COL.—About twenty new telephone lines are being built south to Silver Creek and adjoining towns by the Colorado Telephone Company.

KANSAS CITY, MO.—The Haley Telephone Company, which has a franchise to install a telephone system at Independence, is hastening the work.

ALBERT LEA, MINN.—The American Telephone and Telegraph Company will build a line into this county, having already secured the right of way.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company has completed its copper toll line connecting with the New Bedford automatic exchange.

JEFFERSON CITY, MO.—The Liberty Telephone Company, of Liberty, has filed articles showing that it has made an increase in its capital stock from $15,000 to $25,000.

LOCKHART, TEX.—The Commercial Telephone Company has been granted permission to erect a telephone line from the county line on the San Marcos & Lockhart to Lockhart.

NORTHAMPTON, MASS.—The Southern Berkshire Telephone Company has been organized, and will connect Great Barrington with Alford, Egremont, Suffield, New Marlboro and Monterey.

WILMINGTON, N. C.—The Southern Bell Telephone Company will erect a $16,000 building in Charlotte, and spend about $35,000 in equipping a new exchange and placing its wires underground.

LINCOLN, NEB.—The Golden-Rod Telephone Company, of Wahoo, has filed amended articles of incorporation with the Secretary of State, increasing the capital stock from $50,000 to $150,000.

PETERSBURG, VA.—The Petersburg Telephone Company has secured the right of way to Chesterfield Courthouse, and will at once establish communication between Petersburg and that place

SPRINGFIELD, MO.—At the annual meeting of the Home Telephone Company the following directors were elected: H. B. McDaniel, F. J. Curran, A. J. Eisenmayer, W. D. Tatlow, E. B. Bentley, B. E. Meyer and C. O. Trask.

BROCKPORT, N. Y.—The Brockport Telephone Company has been incorporated with $10,000 capital, the directors being Frank A., A. P. and G. L. Winne, James Brenman, Thomas H. Dobson, Mary E. Talman and James Conley.

HAGERSTOWN, MD.—The Chesapeake & Potomac Telephone Company has completed its new line to Harper's Ferry, Weverton and Sandy Hook, connecting with Hagerstown. All iron wires in Hagerstown have been replaced by copper wires.

BIRMINGHAM, ALA.—At the annual meeting of the stockholders of the People's Home Telephone Company, the following directors were elected: H. H. Stambaugh, A. E. Adams, J. Vautrot, Jr., D. M. Forker, W. H. Hassinger, H. L. Badham and H. B. Gray.

REYNOLDSVILLE, PA.—A farmers' telephone line will be built from Knoxdale to Reynoldsville, *via* Emerickville. A line is being constructed from Knoxdale to Brookville, *via* Cool Spring, and another is now in operation from Knoxdale to Punxsutawney.

SHELBYVILLE, ILL.—The Queen City & Shelby County Mutual Telephone Company has been incorporated with a capital of $10,000 to construct and maintain a telephone system. J. F. Ulmer, S. A. Richardson, J. H. Thomas, G. Griffith and W. O. Bennett are the incorporators.

PHILADELPHIA, PA.—By a unanimous vote, the stockholders of the Bell Telephone Company have voted to increase the capital stock of the company from $12,000,000 to $16,000,000. The additional money will be employed in making improvements in this city and surrounding territory, and extending the lines.

BANGOR, ME.—The Cumberland Telephone Company has been organized at Portland for the purpose of doing a general telephone and telegraph business in Cumberland County, with $50,000 capital stock. The officers of the company are: President, Milville E. Kelley, of Saco, Me.; treasurer, Alexander Speirs, Westbrook, Me.

AUGUSTA, ME.—The Central Maine Telephone Company has been organized at East Fairfield, Me., for the purpose of operating telephone lines in Kennebec, Somerset, Waldo and Penobscot counties, with $10,000 capital stock. The officers are: President, M. D. Holt, of East Fairfield; treasurer, C. M. Holt, of East Fairfield.

PATERSON, N. J.—The stockholders of the Paterson, Passaic & Suburban Telephone Company have elected the following directors for the ensuing year: C. W. Kline, E. C. Stokes, W. Dumont, B. Gummere, J. W. Lindsay, H. H. Hamil, G. A. Post, W. S. Hancock, W. Bamford, F. A. Demarest, J. D. Patton, S. Sheldon and W. D. Blauvelt.

ALBANY, N. Y.—The State Line Telephone Company has been incorporated to operate a telephone line, connecting Albany, New York city, Syracuse, Rochester, Buffalo and other places in this state and in Canada. The capital is $1,000,000, and the directors are William Engert, George Engert, C. W. Andress, R. P. Lyon, D. A. Nesbitt and E. A. Reynolds, of New York city, and H. N. McKay, of Brooklyn.

HAMMONTON, N. J.—It is stated that it is the intention of the Interstate Telephone Company to erect its trunk lines to Atlantic City, to connect with the Eastern Telephone Company, which will build from Camden to this point. The former company has secured a franchise to build lines throughout Atlantic County, while the Eastern company has similar privileges through Camden County. This combination will give an independent long-distance telephone service between Atlantic City and Philadelphia.

ELECTRIC RAILWAYS.

WARREN, OHIO—Work has been commenced on the new Middlefield-Sharon electric line. The first section to be opened will be between Middlefield and Bloomfield.

ELKTON, MD.—At a recent meeting of the Chesapeake City Electric Railway Company the contract for the building of the road was let. The work is to be completed by October 31.

SUNBURY, PA.—The Edgewood trolley line will be extended through Coal Township to Zerbe Township and Trevorton, and then on into Lower Augusta and to Sunbury, connecting with the line there.

COLUMBUS, OHIO—The Marion & Findlay Electric Railway Company, with a capital of $10,000, has been incorporated by J. W. Scott, R. M. Shutt, Charles E. Watson, W. K. Stanley and R. B. Oliver. The line will connect Marion and Findlay, touching Marseilles and Forest.

ATHENS, GA.—It is stated that the proposed electric road from this city to Carnesville, in Franklin County, will be built. The new road will be the longest electric line in the state, the distance from Athens to Carnesville being about thirty-five miles by the route to be followed.

KANSAS CITY, MO.—The Oklahoma Traction Company has been organized to build an electric line between Oklahoma City and Guthrie, a distance of thirty miles, and work will be commenced shortly. In addition, the company will operate street railway systems in the two cities. Power-houses will be erected at both towns.

VINCENNES, IND.—The preliminary contracts for the construction of the Southern Indiana Traction Company's line have been let, and it is expected that work will begin some time during the summer or early fall. The line will be forty-three miles in length, and will start at Vincennes, passing through the towns of Monroe City, Petersburg, Algiers, Otwell, Ireland and Jasper. The road will be used to carry freight as well as passengers.

HOUSTON, TEX.—It is said that the Electric Interurban Railway Company will build two lines between Galveston and Houston, and in all probability purchase the Galveston Street Railway Company's property. One of the lines between Houston and Galveston has been surveyed. This will be an air line running between the lines of the Galveston, Houston & Henderson and the Gulf, Colorado & Santa Fe railways.

FORT WAYNE, IND.—The Fort Wayne & Springfield Railway Company, another interurban line which proposes to operate between Fort Wayne, Middletown, Decatur, Monroe, Berne, Geneva, Portland and Pleasant Mills, has incorporated. The company has a capital of $300,000, and the directors are: William H. Fledderjohann, John H. Koenig, Benjamin A. Fledderjohann, Edwin J. Hoppel, Willis Armstrong, Edward Fledderjohann and Christian Vogt.

FREELAND, PA.—A number of Freeland citizens have organized a new company to be known as the Freeland Electric Coach Company, which is virtually a branch of the Trackless Trolley Company, of Scranton. A charter has been granted and an organization effected with the following officers: President, Hugh Malloy; vice-president, Albert Goeppert; secretary, S. J. Neuberger; treasurer, M. Schwabe. A line will be run to Upper Lehigh, St. Johns, Eckley, Sandy Run and other towns.

ALLENTOWN, PA.—The Easton & Belvidere Street Railway Company has awarded the contract for the building of its road, and work has been commenced. The road will be built from Siegfried, Pa., across the country to Belvidere, N. J., tapping several boroughs and villages. It will be forty-three miles in length. The directors of the company are: W. S. Read, Leominster, Mass.; Charles A. Shipper, Milford, Mass.; Michael J. McGawley, Boston; John McGawley, Lowell, Mass.; E. B. Fullen, Haverhill, Mass.; Charles A. Richardson, Boston; Howard Mutchler, of Easton.

DECATUR, ILL.—The sale of the Decatur street car system has been effected, a syndicate of eastern capitalists represented by W. B. McKinley, of Champaign, purchasing the entire issue of $250,000 in capital stock for $200,000. The system has been bonded for $212,000. The syndicate already owns street car and interurban systems, gas and electric lighting plants in several cities in Illinois and Indiana. It is now building interurban systems that will eventually be joined and make an electric railroad from Danville through Champaign and Decatur to Springfield, thence to St. Louis.

ELECTRIC LIGHTING.

FLORENCE, NEB.—At a meeting of the city council a proposition was submitted by the Omaha Electric Light and Power Company to install arc lights in the city for street lighting and a price made for lighting business places and dwellings—the city to enter into a ten-year contract with the company—the lights to be in operation within sixty days after the contract is signed.

LOGAN, UTAH—Members of the electric light plant committee have visited Logan cañon for the purpose of selecting a location for the city's power-house. They state that work will begin on the structure in the near future. Lumber is being rapidly received from Oregon and the work of manufacturing the pipe is in progress. It will be placed in position as rapidly as completed.

ALPENA, MICH.—The Alpena Light, Heat and Power Company has been organized under the laws of Maine, with a capital stock of $500,000. The company is to develop the water power of the Thunder Bay River and generate power for manufacturing institutions of the city. The new corporation will also take over the waterworks system, the electric lighting plant and the gas plant, all separate companies.

COLUMBUS, OHIO—Announcement has been made that the fund derived from the sale of bonds to provide for the construction of a municipal electric lighting plant, $232,000, was about exhausted and that a deficit of considerable proportions was inevitable. To complete the plant the pole line must yet be provided for, there will be needed a crane, steam pipe-fitting and some small pumps. The outside construction will be a heavy item unless poles should be rented. That question is undecided.

OMAHA, NEB.—The Omaha Electric Light and Power Company, a recently organized corporation, has taken over the property of the Omaha Thomson-Houston Electric Light Company, together with the two lighting companies of Council Bluffs. Floating indebtedness of $40,000 and bonded indebtedness of $298,000 will be taken up and new bonds to the extent of $1,500,000 will be issued. The new company is organized under the laws of Maine and some of its heavy stockholders are residents of Boston. There will be no change in the management of the concern.

JACKSONVILLE, FLA.—The power-house of the West Palm Beach Electric Light and Power Company has been completed, and turned over to the company. Those who have charge of the work of installing the plant have promised to turn on the lights by the first of December, and it now looks possible to keep this promise. Two carloads of poles have arrived, and these will be placed in position immediately. The machinery for the power-house will not be shipped until the end of the month, but in the meantime a great deal of the outside wiring is to be done, and the work of completing the system carried forward with all possible haste.

SEATTLE, WASH.—City Engineer Thomson has asked the city council to appropriate $26,200 for work on the municipal light plant during August. Now that the money for full construction of the system is assured, the city officers feel no hesitancy in appropriating money from the general fund, to be returned when the money from the sale of the bond issue is in the vaults. Mr. Thomson wants to get the timber crib down in position during extreme low water in Cedar River this fall, and he intends to rush things to do this. The city has now 150 men at work on Cedar River and more men will be added during the low water season. In segregating his items of expense for August, Mr. Thomson fixes the sums as follows: Field party complete, $1,000; labor on flume, supplies, etc., $3,200; labor and material for timber-crib dam, $8,000; power-house station, $3,000; right-of-way clearing, $3,000; total, $26,200. The clearing of right-of-way, building of flume station, etc., will be done by the city. The contracts to be let cover mainly the electrical equipment.

INDUSTRIAL ITEMS.

THE PNEUMATIC ENGINEERING COMPANY, 128 Broadway, New York city, has issued a new catalogue describing apparatus for pumping by compressed air. The book contains a great deal of information and the illustrations are well executed.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is distributing an attractive souvenir in the form of a dice-box and dice. A celluloid strap which encircles the box bears the legend "Winners—Cutler-Hammer Field Rheostats."

F. B. BADT & COMPANY, Monadnock Block, Chicago, Ill., has taken the agency at Chicago for Field clay conduits, manufactured by C. J. Field, New York city. W. G. Nagel Electric Company, Toledo, Ohio, has taken the Field agency for Ohio, Indiana and Michigan.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., is distributing its catalogue of interlocking and signal devices. Section 3 shows the assembly and presents half-tone reproductions and diagram illustrations of all the parts of mechanical locking and operating devices.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, announces that owing to the rapid increase in its eastern business, it has been found necessary to move into larger quarters, and the company is now located in the Engineering Building, 114 Liberty street, New York city.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, Niles, Ohio, manufacturer of "Star" incandescent lamps, is meeting with large sales of its products. F. W. Stillwagon is president, W. H. Pritchard, vice-president, and J. P. Gilbert, secretary and treasurer of the company.

THE J. H. WHITE MANUFACTURING COMPANY, Brooklyn, N. Y., is distributing its new catalogue descriptive of electric gas and combination fittings, shells and trimmings, and lighting specialties. This covers an extensive line of brass goods, a careful alphabetical index makes reference to any particular apparatus easy.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, calls attention to its "Anti-Sweat" pipe covering. This prevents condensation on the surface of the pipes and stops all dripping from "sweat." It also protects the pipes from rust and decay. Full information, samples and prices will be forwarded on request to the company.

THE McGUIRE MANUFACTURING COMPANY, Chicago, Ill., has issued a handsome calendar for the six months beginning July, 1903. On each leaf is a fine half-tone reproduction of a piece of apparatus made by the company. These are, respectively, a pneumatic sprinkling car, a rotary snow sweeper, when not in use as a sweeper this can be used as an electric locomotive or freight car; a motor-car truck, a solid steel Columbian truck, a 39-A double truck for interurban and high-speed city service, and a Maximum traction truck No. 3.

THE STANDARD PAINT COMPANY, 100 William street, New York city, is distributing a "Ruberoid album" as a souvenir of the twelfth year of success of "Ruberoid" roofing. This is a weatherproof elastic and odorless material. The outer covers of the album are intended to show the appearance of "Ruberoid" roofing, which is a dark gray in color, presenting a smooth finish surface when laid. The illustrations show the great variety of structures to which this material has been applied with unvarying success.

THE ALLIS-CHALMERS COMPANY, Chicago, Ill., has issued an elaborate souvenir catalogue, descriptive and illustrative of Reynolds-Corliss engines, built exclusively by the Allis-Chalmers Company, at the Edward P. Allis Works, Milwaukee, Wis. Following views of a number of the Allis-Chalmers works, are views in the several departments of the Edward P. Allis Works. These are followed by views of typical machines and installations of street railway engines, electric light engines, pumping engines, blowing engines, rolling mill engines, hoisting engines and air compressors.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has recently been awarded a contract by the Pittsburg & Allegheny Telephone Company for a 3,000-line common battery, multiple switchboard for McKeesport, Pa. Present equipment, 1,000 lines. The company has also received an order from the National Telephone Company, of London, England, for an 800-line common battery board for Lavender Hill, London. A contract has also been awarded it for the entire exchange equipment at Pasadena, Cal. This is a 7,200-line switchboard, with 1,500 lines equipped. The contract includes the telephone instruments.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., is distributing a new catalogue entitled "Instructions for the Care of the Exide Battery in Electric Vehicles." This describes and illustrates in detail all battery parts; gives directions for installing and assembling battery in a vehicle; describes switchboard and charging connections, the charging of batteries in vehicles, the charging of batteries when removed from vehicles, excessive and injurious overcharging, the treatment of batteries used but occasionally, and the putting of batteries out of commission. This is supplemented by the general rules for the proper care of a battery.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Boston, Mass., has been publishing some very attractive literature, beginning with the May issue of *Edison Light*. This little publication illustrates the untiring efforts which the Edison company is making to give the population of Boston the very best quality of service, both for illumination and power. The company has recently issued a bulletin giving advance information regarding points where electric automobile batteries may be charged. This gives the charging stations on the line of the Edison company in Greater Boston, and also the places in Massachusetts not on the Edison lines, as well as places in Connecticut, Maine, New Hampshire and Rhode Island.

THE LAGONDA MANUFACTURING COMPANY, Springfield, Ohio, has every reason to be satisfied with the rapid success made by its boiler-tube cleaners. So great has been the demand that the Lagonda company was recently forced to build a new and greatly enlarged factory, which has been thoroughly equipped with special tools and machinery. Even in the new quarters, however, the company is forced to run overtime to keep up with orders. This prosperous condition has been arrived at by the efficient and careful management of Mr. Bradley and the practical engineering equipment of Mr. Weinland which has enabled him to produce a boiler cleaner which removes scale and which not only works rapidly but is strong and lasting.

MESSRS. E. P. ROBERTS & COMPANY, Cleveland, Ohio, consulting engineers, have opened a department of cement engineering and are now prepared to take entire charge of the designing and supervision of the construction and operation of cement plants. This firm has been in business for ten years and has large experience in electrical, mechanical and civil engineering, having had the consulting and supervising work for a great number of electric railways, electric lighting and power plants, manufacturing plants, etc. The cement department opens up a new field and the services of George S. Perkins, M. E., have been secured to look after the work. Mr. Perkins is a graduate of Stevens Institute of Technology, class of 1891, in the course of mechanical engineering and has had an extensive experience in the designing and constructing of cement plants.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., has recently sold a two-position toll line board equipped with selective lock-out and toll line apparatus to the Citizens' Telephone Company, of Mankato, Minn. A switchboard and entire exchange equipment have been sold to the Lewiston Telephone Exchange Company, of Lewiston, Minn. The Minot Light and Telephone Company, of Minot, N. D., has purchased recently additional switchboard apparatus. The Madelia Telephone Company, of Madelia, Minn., has also bought an entire switchboard equipment. The Stromberg-Carlson company has also sold twenty selective lock-out equipments to the Independent Telephone Company, of Winthrop, Minn., and a quantity of telephones to the Farmers' Mutual Telephone Company, of Volga, S. D. Bulletin No. 5, which has just been issued, describes and illustrates a fine line of central energy telephones. This bulletin is handsomely printed, and will be sent on application to the company.